UNION OF SOUTH AFRICA

DEPARTMENT OF AGRICULTURE

JOURNAL

OF THE DEPARTMENT OF

AGRICULTURE

VOLUME XI—JULY TO DECEMBER, 1925

Published by the
DEPARTMENT OF AGRICULTURE
PRETORIA

PRETORIA
THE GOVERNMENT PRINTING AND STATIONERY OFFICE
1926

Printed by the Government Printer, Pretoria.

9301—11/12/25—4,000

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JULY, 1925.

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DEPARTMENTAL NOTICES.

SALE OF POULTRY.

A limited number of good birds of the following breeds is available for sale at the Glen School of Agriculture, Orange Free State:—

Cockerels.—Light Sussex, Speckled Sussex, Indian Game, Austro Black Orpingtons, Rhode Island Reds, American Bronze Turkeys.

Pullets.—Indian Game, Rhode Island Reds, Austro Black Orpingtons, South African Utility White Leghorns, Light Sussex.

Two-year-old Hens.—Rhode Island Reds, Indian Game.

All birds are bred for utility and not for show. Price 25s. per bird: turkeys £2. 10s. each. Terms: Buyer to pay railage and coop to be returned. Birds are sent at buyer's risk. Cash with order direct to Principal, School of Agriculture, Glen.

VACANCIES FOR STUDENTS AT GOVERNMENT TRAINING FARM, BEGINSEL.

There are vacancies for students at the Government Training Farm at Beginsel, Standerton, and any one desirous of obtaining admission should make early application to the Principal, School of Agriculture, Potchefstroom, from whom full particulars can be obtained.

The Farm is intended to give an essentially practical training in agriculture which will equip men to become satisfactory settlers or qualify them to become farm managers or overseers.

The length of the course is twelve months and the instruction will be *free to residents* in the Union, but students are expected to give their services on the farm in return for board, lodging, and ordinary medical attendance.

BULLETINS FOR FARMERS.

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SEPTEMBER, 1925.

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DEPARTMENTAL NOTICES.

DEPARTMENT OF AGRICULTURE.

SALE OF PEDIGREE STOCK.

A special unreserved sale of pedigree stock will be held at the Stock Fair Yards, Potchefstroom, on Wednesday, 16th September, 1925:—

Cattle (Frieslands).—4 Young pure-bred bulls, 4 pure-bred cows (1 with calf at foot), 1 pure-bred heifer, 2 grade heifer calves, 2 grade bull calves.

Sheep (Wanganella).—12 Selected flock rams, 11 flock rams.

For catalogue and further particulars apply to Principal, School of Agriculture, Potchefstroom.

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The following are some of the more important bulletins available:—

3d.	Pear Scab in the Western Cape Province	2/1922
3d.	Valuation of Manures and Farm Foods	Repr. 40/1924
3d.	Cheddar-cheese Making	Repr. 6/1923
3d.	Breeding for Milk	Repr. 30/1924
3d.	First-grade Cream and Cream Tests	Repr. 47/1924
—	The Manufacture of Stilton and Wensleydale Cheese	20/1925
1/6	The Maize-stalk Borer	3/1920
—	Codling-moth Control in the Western Cape Province Districts	Repr. 51/1923
3d.	The Eucalyptus Snout-beetle	Repr. 51/1924
3d.	The Elegant Grasshopper	Repr. 2/1925
3d.	Crops and Feeding Stuffs—Composition of	5/1919
3d.	Economics of Maize-growing	Repr. 9/1924
3d.	Lucerne Cultivation on Irrigated Holdings	Repr. 35/1924
3d.	Profitable Potato Production	Sc. B. 35
—	Selecting Seed Maize	Repr. 14/1925
3d.	Cotton Culture	Repr. 2/1924
3d.	Cotton: Fertilizers and Crop Rotations	Repr. 4/1924
—	A Jassid-resistant Cotton	Repr. 26/1925
—	How to Produce Good Turkish Tobacco	Repr. 26/1923
3d.	Tobacco Soils and Fertilizers—Experiments	Repr. 38/1923
—	Tobacco-seed Beds	Repr. 1/1924
3d.	Raisin-making in South Africa	1/1916
1/6	Citrus-growing in South Africa	U.P.
3d.	Citrus—Export of	3/1922
3d.	Fruit-drying	Repr. 17/1923
—	Packing of Apples in Boxes	Repr. 1/1925
1/6	The Apple	1/1925
3d.	Breeding for Beef	Repr. 29/1923
3d.	Poultry Yard Month by Month	Repr. 16/1924
3d.	Water-fowl	8/1925
3d.	Causes and Prevention of Some Diseases of Domestic Birds in South Africa	21/1925
1s.	Wool Industry, The	4/1920
3d.	The Management of a Sheep Farm	Repr. 17/1924
3d.	Sheep-shearing	29/1924
1s.	Sheep-shearing and Drafting Sheds	Plans
6d.	Phosphorus in the Live Stock Industry	Repr. 18/1924
3d.	Table Grapes	Repr. 3/1925
3d.	American Stocks in Viticulture	Repr. 17/1925

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OCTOBER, 1925.

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DEPARTMENTAL NOTICES.

SALE OF SETTINGS OF EGGS AND DAY-OLD CHICKENS.

The practice of selling settings of eggs and day-old chickens at the Schools of Agriculture has now been abolished, as the Department does not wish to compete against private breeders. Moreover, there have been instances where eggs had to be sent long distances, and after their lengthy journey buyers failed to get satisfactory results. The sale of adult poultry at reasonable prices is still in vogue at the Schools.

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3d.	Agricultural Experiment: Its Design and Interpretation	Sc. B. 22.
1s. 6d.	Investigations on Export Citrus Fruit from S.A. during 1921	1/1922.
1s. 6d.	Further Investigations into the Cause and Wastage in Export of Citrus Fruits from S.A.	1/1921.
3d.	Diseases of Sugar-cane of the Mosaic Type in S.A.	Repr. 32/1924.
3d.	Silver Leaf Disease of Fruit Trees in S.A.	Sc. B. 27.
3d.	Streak Disease of Sugar-cane	Sc B. 39.
3d.	Some Experiments on the Solubility of Saldanha and Grahamstown Phosphates in the Soil	Sc. B. 36.
6d.	Cost of Production of Maize Investigation, Season 1921-22	Sc. B. 33.
3d.	Olives	63/1923.
3d.	Kemp Fibres in the Merino Sheep	Sc. B. 34.
3d.	Development of Merino Wool Fibre	U.P.
—	Anthrax	7/1924.
—	Comparative Results of Analyses of Spirits and Brandies	Sc. B. 37.
—	Jointed Cactus	Repr. 38/1924.
3d.	Valuation of Manures and Farm Foods	Repr. 40/1924.
—	Care and Management of the Dairy Cow	Repr. 11/1924.
3d.	Destruction of Rodents by the use of Poison ...	4/1921.
1s. 6d.	The Maize Stalk Borer	3/1920.
1s. 3d.	Remedies and Advice: Treatment of Insect Pests	(Chart.)
—	Onion-growing	Repr. 15/1924.
—	Selecting Seed Maize	Repr. 14/1925.
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1s. 6d.	The Apple	1/1925.
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—	Non-specific Gall-sickness of Cattle in S.A.	Repr. 8/1923.
—	Retention of the Foetal Envelope (Afterbirth) in the Cow	Repr. 48/1923.
6d.	Phosphorus in the Live Stock Industry	Repr. 18/1924.
—	The Spinose Ear-tick	Repr. 7/1925.
3d.	American Stock in Viticulture	Repr. 17/1925.
2s.	Comparative Study of the Citrus Industry in S.A.	6/1925.
3d.	Tobacco Cultivation for Nicotine	2/1925.
3d.	Table Grapes	Rep. 3/1925.
1s.	Fungous and Bacterial Diseases of Plants	L.S. 78.

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3d.	Fruit Drying	Repr. 17/1923.
3d.	Citrus, Export of	3/1922.
3d.	Raisin-making in South Africa	1/1916.
3d.	Chemical Investigations in regard to Citrus	Sc. B. 40.
3d.	Report on the Cost of Production of Maize Investigations, 1922–23	Sc. B. 38.
3d.	Some further Remarks on Tobacco Cultivation for Nicotine	2/1925.
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ANNUAL REPORT

OF THE

DEPARTMENT OF AGRICULTURE

FOR THE

YEAR ENDED 30TH JUNE, 1925.

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ANGORA GOATS, GRAAFF-REINET DISTRICT, CAPE.

[*Photo S. A. R. & H.*

JOURNAL OF THE DEPARTMENT OF AGRICULTURE.

VOL. XI. JULY, 1925. NO. 1.

Published monthly in English and Afrikaans by the Department of Agriculture Union of South Africa.

SUBSCRIPTION: Within the Union and South-West Africa, 5s. (otherwise 6s.) per annum, post free, payable in advance.
Applications, with subscriptions, to be sent to the Government Printer, Pretoria.

NOTES.

The Mesquite as a Fodder Crop..

The value of the mesquite or algaraba tree (*Prosopis juliflora*) as an outstanding means of furnishing fodder for our stock under the conditions that prevail in South Africa has been advocated for many years. Over ten years ago an article on the subject by Mr. C. A. Robertson of the Forest Department appeared in the Department's *Journal*, while in January, 1923, Mr. W. Robertson Brown contributed to the *Journal* an article on the success of the mesquite in India and its suitability for propagation in the arid and semi-arid areas of the Union. Since then the matter has also been the subject of correspondence in the Press. It is specifically mentioned in the Final Report of the Drought Investigation Commission, a document of utmost moment to stock farmers and others, where it is suggested as a means of providing a fodder reserve. The report describes the tree as furnishing valuable fodder, growing readily under extremely arid conditions, and not requiring protection from stock owing to its formidable thorns. The nutritious pods, the report adds, are relished by cattle, horses, sheep, and pigs, and the tree is well worth trying in the drier parts of the interior, especially in districts in which ordinary fodder crops cannot be grown with certainty and on poor soils or eroded ground not suitable for better crops.

One of the chief advocates of the mesquite is Sir Thos. Smartt, who has introduced it on the Smartt Syndicate Farms, Bristown District. Visiting this area in 1922, the Conservator of Forests, Bloemfontein, wrote: "I found it (the mesquite) growing at Smartt's Syndicate, being spread about in the veld by sheep eating the pods, and

holding its own with the natural vegetation." Writing to the Forest Department in October of last year, Sir Thos. Smartt states: "The mesquite bean tree, now that we have found out that by removing the pod and the capsule round the seed it germinates quickly, should be easily established in the Karroo. We have a few trees near our house at the head station, and I find a few trees coming up in the veld, evidently planted by our stud sheep, which eat the pods freely; and once the tree comes up, even though the stock nibble it, it struggles along. . . . Patches of shade trees in the Karroo would help the animals greatly. . . . Our difficulty was getting the seeds to germinate."

In a letter to this Department a few weeks ago, the same writer (in enclosing the photograph of the mesquite grown at Doornkuilen, here reproduced) observes: "No doubt clumps of these trees would

Mesquite (*Algaraba*) Trees.

revolutionize our Karroo; once started, no drought seems to kill them, and we find the sheep spread them, after eating the seed, in their droppings."

The mesquite was found to thrive at the late Experiment Station at Robertson, but the trees had to be removed to permit further development there; at the Grootfontein School of Agriculture, Middelburg, Cape, young mesquite trees (propagated from seed supplied by Sir Thomas Smartt) are now promising well.

The mesquite, like the carob tree, which is also suited to hot, dry districts with stony soil, is undoubtedly worthy of greater attention than has been given it heretofore by farmers. Indeed, it is difficult to understand the lack of foresight that loses the opportunity of providing, by means of the mesquite and other plants, the fodder so essential to success in stock farming in a land where the dry seasons are regularly to be expected.

The Farmers' Tour of 1925.

The Farmers' Tour, comprised of fifty-nine men and four women members and organized by the South African National Union, left Capetown for England early in May. Before leaving, the party was addressed by General Kemp, Minister of Agriculture, Mr. Du Toit, Secretary for Agriculture, and Mr. H. E. V. Pickstone, Chairman of the Federation of Farmers' Co-operative Associations of South Africa. A tour of a similar nature in 1914 had been disappointing, inasmuch as there was no subsequent publication of the lessons learned, and the wish was expressed that the present tourists would, on their return, spread the knowledge obtained in their travels. Special attention was directed to the need for studying co-operative methods, so as to assist South Africa in proceeding on sound lines. The tour is intended to bring the farmers into touch with the actual operations of oversea markets, to show them the extent of the European demand for South African products, and the importance of quality and pack. It is hoped that its educative results will prove of great practical value to all participating and to the large circle of farmers that will subsequently benefit from the experience of the tourists.

The Drought Problem.

The final report* of the Drought Investigation Commission, published in 1923, is likely to stand for many years as one of the most interesting and important of our Blue-books. It has already received considerable attention from all sections of the community (for all are concerned in the conditions it discloses), and it is to be hoped that the valuable lessons it contains and the warnings it sounds will continue to be heard throughout the land until the danger is past. One of the features of the report is its comprehensive collection of coloured maps, and students of the pressing problems of drought and soil erosion that are discussed will find the cost of the report insignificant in comparison with the wealth of information contained in the maps alone, many of which are the first of their kind to be published. Unfortunately the supplies of the report are limited, and the publication, moreover, is not within the reach of the public generally. Excellent summaries and lengthy extracts of the report have appeared in the Press at various times, but the subject is of such importance, and is interwoven so intimately in the life of the farming community, that it has been decided to publish in the *Journal* a brief summary of the report in a series of short articles.

It is the intention that these articles will give the salient points of the report and possibly convey the spirit that breathes throughout its pages and makes its arresting appeal. When the series is completed, it is proposed to reprint it under one cover and distribute it freely in the hope, particularly, that its teachings will find their way through the schools to the hearts of the coming generation of farmers from whom much is expected in circumventing the evils that are overtaking us. The first of the series is published in this issue of the *Journal*.

* No. U.G. 49, 1923, obtainable from the Government Printer, price 12s. 6d.

Argentine Maize.

The following table shows the production of maize in Argentine, whose exports to Europe play an important part in determining the price of the Union's export maize:—

1924-25	52,294,000 bags of 200 lb.
1923-24	77,493,000 ,, ,,
1922-23	49,310,000 ,, ,,
1921-22	49,329,000 ,, ,,
1920-21	64,518,000 ,, ,,
1919-20	72,433,000 ,, ,,

It will be observed that there have been considerable fluctations in the output over the period shown above. But it extends to earlier years as well. In 1916-17, for instance, the yield was as low as 16,475,000 bags, whereas two years previously (1914-15) it was 91,051,000 bags, a figure indeed which has not since then been reached.

According to a recent report of the International Institute of Agriculture, the world's production of maize in 1924-25 is estimated at nearly 879 million bags, which is about 17 per cent. less than it was the year before and about 9 per cent. less than the average production of the previous 5 years. While this vast quantity includes the output of practically all the principal maize producing countries of the world, it does not include that of the Union, which may be estimated at, say, 18 million bags this year, so that the total world production in 1924-25 will be nearly 900 million bags.

A comparison of the quantities exported overseas shows how the Argentine trade outstrips our own at present, the exports in recent years (1921-23) being from 31 to 32 million bags, against our average of about 4¼ million bags for the three seasons ending 1924-25.

The Union's Expanding Fruit Trade.

During the deciduous fruit export season just over about 1,541,000 boxes of fruit were shipped to the oversea market, showing an increase on the previous season (1923-24) of over 50 per cent. Citrus export this year is expected to show a similar increase, for it is estimated that 800,000 boxes will be shipped as against 522,000 boxes in 1924.

It is the opinion of those intimately associated with our fruit growing industry that in three years' time there will be an annual output of three million boxes of oranges alone available for export. To transport this great quantity of fruit presents a problem of some magnitude. It would require 770 train loads, each containing 13 trucks; in other words, on an average, 4 such train loads would need to be dispatched every day for six months. The bulk of our trade, however, falls in the months of June, July, and August, so that during those months in three years hence an average of about 6 train loads of 13 trucks each will be taking daily their full freight of oranges to the ports for shipment.

This will indicate the rapid expansion of our fruit industry which last year exported fresh and dried fruit to the value of £459,000.

The Mohair Industry.

The policy of many years' standing which secured to South Africa the virtual monopoly (apart from Turkey) of angora goat farming has now been reversed, and the first shipment of South African bred angora goats has left the country, consigned to the United States of America.

The reason, briefly, of the change of policy which, it need hardly be said, was introduced only after long and earnest consideration by those concerned in the industry, is to encourage a wider investment in the primary industry; in turn this will induce a greater production of the raw material, which again should lead to more industrial activity; and thus, with more interests involved in turning out the manufactured article, the wide use thereof would be prosecuted with greater vigour than with an article which, as at present, depends for its raw material upon the necessarily limited production of two countries only.

It must be recognized that our mohair industry, built up so carefully and scientifically, cannot expand indefinitely. The area of the Union suitable for angoras is limited. To-day we produce the greatest quantity of mohair in the world. But the total world production of good mohair is not sufficient to secure investment by manufacturers in more machinery to turn out a wider variety and quantity of articles from mohair than at present, and extending the market therefor.

With a greater supply of mohair such expansion can logically be expected. The world's demand for wool is greater than the production, cotton even being used with wool in order to provide articles to meet all requirements. Then, why should over-production of mohair be feared? It is not a luxury in the manner that the ostrich feather is. South Africa looks to America as one of its markets for mohair, and there are some who predict that as soon as that country has built up (on importations from the Union) a sufficiently strong mohair industry, the South African product will no longer be needed. But America is also a great producer of wool, yet notwithstanding a high protective tariff, she remains a big importer of wool. Is it not then feasible, at least, to expect that great and growing country to use not only all the mohair grown there, but also supplies from South Africa, as is now being done with our wool?

The future will show the effect of the new policy. It is awaited with confidence. At the outset, the trade in live animals that has now commenced with America will in itself be an excellent advertisement to our industry. But whether ultimately South Africa benefits or not, one thing we do know, and that is that our almost exclusive supply of mohair has been a business of uncertainty. The demand has not been stable, nor can there be foreseen any marked change so long as the limit of supply of the raw material is restricted as at present. The urge of greater production will, we hope, stimulate manufacture.

But a warning to South African producers must be sounded. Some time ago the buyers of Bradford stated that the quality of our mohair was falling off; and that there was truth in their assertion was proved in the samples of mohair submitted by them. We are now deliberately placing the means of producing mohair in the hands of

competitors. Let us recognize the limits of our country suitable for this class of farming. Having done so, let us vigorously pursue methods that will produce the class of mohair the world will need; otherwise our second state will be worse than our first.

Apple Culture. A Valuable Publication.

The latest bulletin* of the Department—"The Apple"—written by Mr. Terry of the Potchefstroom School of Agriculture, is a timely and much-needed publication, judging alone by the requests received by the Department for literature on the subject of apple growing. While recent developments in the deciduous fruit industry have considerably widened the horizon of the export trade by demonstrating that this class of fruit can be made a commercial proposition in the northern parts of the Union hitherto considered outside the radius of the overseas market, the apple has long proved its suitability as an economic proposition in numerous areas throughout the country, the range of suitable localities being very great, and in the rapid expansion of commercial orcharding during recent years the apple has been shown preference, apple trees being planted out in their thousands with a view to the supply of the markets outside the borders of South Africa. The pressure, however, of the expected apple trade is not yet felt, for large supplies are still being imported from overseas, but is is anticipated that at no distant date our own growings will supply the local market at least. Experiments conducted by the Government and also by private growers have shown that we can grow first-class apples and that good prices are readily obtainable both locally and overseas if the fruit is attractively packed. Very favourable comment was made by visitors to the British Empire Exhibition in 1924 upon the display of apples (drawn from the Western Cape Province and from the Orange Free State) that formed part of the National Fruit Section in our Pavilion at Wembley. Moreover, it is pleasing to know that these apples compared favourably with any on exhibit from other parts of the British Empire. That the market exists is evident. Yet growers must at the outset realize that it is a competitive market, and consequently they must produce their fruit at a price that will be able to bring a profit at returns lower than what is now being obtained locally for our comparatively small output. It must be clearly understood that apple growing, like all classes of fruit growing, is an investment, and that fortunes cannot be made readily or easily. Some years must pass before returns come in, and when the crops at length bring their income it is only with the passing of time that the venture will in the aggregate show an increasing profit. It is not proposed to outline here the scope of the Department's bulletin. Suffice to say that all those engaged in apple growing, or who intend to take it up, will find the cultural aspect of the subject treated fully in every respect. It is based on South African experience and should be in the hands of every fruit grower.

* "The Apple," by H. B. Terry, Cert. R.H.S., London and South Africa; Lecturer and Instructor in Horticulture, School of Agriculture, Potchefstroom. Bulletin No. 1 1925, obtainable from this office. Price 1s. 6d. prepaid.

A Warning against the Introduction of Cotton-seed by Letter Post.

The public is well aware of the great expansion of cotton growing in South Africa and of the important part it is likely to play in the progress of our country. It knows also that every precaution is being taken to guard the industry against the introduction of the cotton pests that are causing serious damage in other countries and that, happily, are not present in South Africa. The welfare of our country intimately concerns every South African, and it is the duty of every one to ensure that no action of his will be the cause of hampering our progress. Thus anything that would prove a set-back to an industry destined to enter largely into our well-being as a people must be prevented. Warning of the danger of introducing serious cotton pests from other countries through the post is again sounded.

The Department has information that small lots of cotton-seed are occasionally received by merchants from oversea under cover of letter postage. The public is cautioned that the introduction of cotton-seed and of other plant material by *letter or sample post* is subject to the restrictions that apply to introductions by parcel post or ship's cargo. Any one who may receive any cotton-seed for which a permit has not been issued by the Department, or which he is not sure has been duly inspected and passed for entry by a competent officer, is warned to communicate at once with the Department of Agriculture, giving full particulars. Even the small quantity of seed under the cover of a letter might establish in South Africa a pest that would greatly handicap our cotton production.

Merchants who are likely to receive samples of cotton-seed by post from oversea are earnestly requested to inform prospective senders of the position. It is recognized that samples of seed are not always solicited, but under the Plant Import Regulations the receiver of any restricted article from oversea may be held responsible for its introduction. The penalty for infringing the regulations is a heavy one. But what incalculable harm may not follow the small parcel of seed, introduced perhaps in all innocence.

A great responsibility rests upon those receiving cotton-seed from outside the Union. It is hoped that every one is now alive to the danger.

DEPARTMENTAL ACTIVITIES.

(NOTE.—The work of the several Divisions and Schools of Agriculture covers a wide range of agricultural industry in the Union, and we give hereunder notes and observations from certain of them treating with matters of special interest coming under their purview month by month. The object of these notes, which are not concerned with general routine work, is to inform the farmer of such matters as are calculated to be of interest and helpful to him.—EDITOR.)

THE DIVISIONS.

ENTOMOLOGY.

Causes of Arsenical Burning of Pear Foliage.—F. W. Pettey, Entomologist, and D. C. Crawford, Chemist, Elsenburg School of Agriculture, report as follows concerning the causes of arsenical burning of foliage, which has been severe during the 1925 fruit season in many pear orchards of the Western Districts of the Cape Province:—

"As a result of a complaint from a fruit grower of pear trees being seriously burned by lead arsenate sprays, an inspection of eleven large pear orchards was made, and samples of lead arsenate were collected from the fruit growers concerned. Considerable foliage injury was found in varying degrees of intensity in all orchards visited. All lead arsenate used was of an acid nature.

"Results of the investigation showed that the burning could not be attributed to any particular brand of lead arsenate. The burning was apparently least where the soil was deepest and the moisture best conserved, and trees suffering from drought were evidently less resistent to foliage injury from spraying than trees well supplied with moisture.

"The analysis of the three brands of lead arsenate used in the orchards concerned led to the discovery that the arsenate of one manufacturer, owing to the inclusion of an added substance, assumed to be beneficial, showed more soluble arsenic present than allowed by the insecticide regulations. The manufacturer concerned has immediately taken steps to rectify the trouble. The investigation has led to the surprising discovery that lime, when added to an acid lead arsenate, renders soluble a certain amount of insoluble lead arsenate.

"A certain brand of acid lead arsenate showed, on analysis, ·07 per cent. water soluble arsenic. After adding to the lead arsenate 10 per cent. calcium caseinate, which was made up of a considerable amount of lime, the water soluble arsenic increased from ·07 per cent. to 1·9 per cent."

Tsetse Flies.—The Division has received from Captain E. St. Vincent Erskine a specimen of *Glossina longipennis*, regarding which he writes:—"Fly taken at a water-hole, long. 39° and lat. 0°, Tana or Safari River, 15th March, 1925; dry season; buffalo, elephant, and water-buck present; fly reported rare. The Somali owners of cattle, goats, and camels water their stock from 11 a.m. until 2 p.m. *to avoid* tsetse fly. . . . Just north of the equator I know of two places where stock is passed at noon to avoid tsetse, the fly there biting worse at night. Here the fly is called in Somali 'ginde,' the 'i' being pronounced in the throat almost like 'u'."

Fruit Moth.—During April, a short test was made by the Eastern Province Entomologist with several poison baits with the object of ascertaining whether these would prove attractive to the fruit moths (*Ophiuza*) which were quite abundant on guavas in an orchard near Uitenhage. The baits used were (1) a sweetened arsenite of soda solution, (2) arsenate of lead in a sugar solution, (3) arsenite of soda solution sweetened with sugar, honey, and treacle, (4) much the same as (3) with the addition of stale beer.

The baits were set out in tins of various sizes, some of which were hung up in the trees, and others left on the ground. Over two tins, holding from two to three gallons, acetylene lamps were placed. To the bait in several tins, crushed guavas were added. Although the moths were present in large numbers, neither the lamps nor the baits were found to attract them.

Cotton Jassid in Zululand.—It was always considered that the area of most severe jassid attacks extends roughly from the northern end of the Transvaal down through the low veld of the eastern part of this Province to the southern end of Swaziland. From five years' observations, it also appears to hold true that these severe attacks always follow prolonged periods of wet and cloudy weather. As was expected, following the recent heavy rains in Zululand, serious outbreaks of jassid occurred southward from Swaziland throughout most of the coastal belt of Zululand and Natal. However, these attacks varied greatly in intensity; and in some instances more damage was done by the rains than by the jassid itself. During a recent trip to Zululand some rather startling discoveries were made as to jassid attacks. It was observed on one farm that Watt's Long Staple, a variety of cotton usually very susceptible to jassid attack, was almost free from attack in some fields, even though the rainfall and its consequent cloudiness and high humidity was excessive during March. This variety and others on near-by farms at present promise to give very fair yields this season. The reason for this unusual state of affairs is not yet known; but it brings up again the question of drainage and local soil and weather conditions, which were considered by us from the beginning of these investigations as very important factors. However, taking the cotton areas of the Union as a whole, we think it advisable that cotton growers grow only the more hairy and jassid-resistant varieties of cotton in areas where serious outbreaks of jassid are known to occur. A closer study of cotton areas in their relation to jassid outbreaks may enable us to state more accurately where and under what conditions cotton may be grown with comparative safety from jassid attack.

Vermeerbossie Grubs.—The Division recently received specimens of vermeerbossie (*Geigeria passerinoides*) from two localities. The plants from both sources were infested with curculionid larvae inhabiting gall-like swellings on the bases of the plants. The first lot was submitted through the Division of Veterinary Education and Research by Government Veterinary Officer F. Frean. The plants came from Vryburg and were accompanied by the statement that, owing to the activities of the insects, one farm was becoming naturally cleaned of the vermeerbossie. The second example was forwarded by Mr. S. A. Hunt, of Fourteen Streams, through the Division of Botany. Mr. Hunt stated that in some places 20 per cent. of the bushes had been killed by this insect. From inquiries since made, it would appear that the existence of this parasite has been known to those working upon the vermeerbossie problem for about five years past and the possibility arises that some other factor is responsible for the death of the plants.

May Itineraries.—The Chief of the Division left on the 22nd May for England to attend the Conference of Imperial Entomologists. Dr. Mally spent a few days early in the month at Vryburg on locust research investigations, and Dr. Potgieter was at Middelburg and Prince Albert, Cape Province, for a few days later in the month on similar work. Dr. Lundie attended farmers' weeks and visited farms in the interests of bee-culture around Oudtshoorn and Cookhouse during the first half of May. Mr. Tooke returned from Cedara, Natal, early in May, and after inspecting gum plantations at Pan and along the Witwatersrand, left on the 9th May for Capetown, where he will conduct further investigations on the Eucalyptus Snout-beetle. Mr. Haines spent the last week in May in Zululand, where he attended a cotton growers' meeting at Empangeni and visited cotton farms in the N'kwaleni valley. Mr. Hodgson and Mr. v. d. Vyver inspected nurseries in the Western Transvaal and in Natal during the month.

BOTANY.

Rosette Disease of Peanuts.—Recent investigations by this Division have thrown light upon the nature of this obscure malady, which has caused serious losses to peanut growers in the Northern Transvaal. Experimental work carried out at Potgietersrust, Pretoria, and Durban by Mr. H. H. Storey and Miss A. M. Bottomley, with the assistance of Mr. J. S. MacKay, has shown the ability of individuals of *Aphis leguminosae* Theo. to transfer the infective agent from diseased to healthy plants. Trials with a number of other suctorial insects, commonly occurring in diseased peanut fields, gave negative results.

This evidence, taken in conjunction with the failure of all observers to detect a visible parasite in rosetted peanut plants, indicates that this disease belongs to the group of "virus diseases," of which the mosaics of many crop plants and streak disease of mealies are other members. The infective principle, or virus, is

now generally supposed to be an organism of ultra-microscopic size; in feeding upon a diseased plant the insect takes up some of the virus, which multiplies in the body of the insect and subsequently passes out into the healthy plants upon which the insect feeds. An insect which has never fed upon a diseased plant is incapable of producing the disease in any plants upon which it may feed; thus, a heavy infestation of peanuts with *Aphis leguminosae* may frequently be unaccompanied by an outbreak of rosette, in which case it must be assumed that the aphids developed originally upon healthy plants. On the other hand, a light infestation with aphids which are infective may lead to the complete loss of the crop.

This discovery now places the future search for methods of control of rosette disease upon a firm basis, and marks an important advance in the study of the problem.

DIVISION OF EXTENSION.

Fourth Tour of the Agricultural Demonstration Train.—The agricultural demonstration train made its fourth tour between 21st April and 11th May, visiting Krugersdorp, Welverdiend, Ventersdorp, Coligny, Lichtenburg, Vermaas, Sannieshof, Delarey, Schweizer Reneke, Taungs, Warrenton, Kimberley, Christiana, Bloemhof, Maquassi, Vierfontein (Orange Free State), Klerksdorp, and Potchefstroom. The attendance at each place, excepting Welverdiend and Taungs, was good, and would have been better but for heavy rains, which made the roads impossible for travelling, and prevented farmers from reaching the halting points.

The tour was very satisfactory from a Departmental point of view, the public showing interest and enthusiasm, and although it was intended chiefly as an advertisement and stopped only at each place for one day, the results obtained on the whole were such as to justify the opinion that the train will play an important and useful part in our country. It is naturally to be expected that the Division concerned (Extension) will add to its experience every time the train goes out and will always effect improvements. This tour has shown clearly that the train should in future stop at each place for more than a day, as one day is much too short a time to go through a comprehensive programme and allow the public to inspect all the coaches and their contents. The object in future will be to place the onus more in the hands of the farmers' organizations concerned as to the route, stopping places, dates, etc., as well as the subjects to be included. It is assumed that "agricultural days" or "agricultural weeks" can easily be so arranged if they can be held along the railway line. It is, however, essential to have a series of such days or weeks, as it would be unpractical to send the train long distances to individual agricultural weeks or shows.

THE SCHOOLS OF AGRICULTURE AND EXPERIMENT STATIONS.

GROOTFONTEIN, MIDDELBURG, CAPE.

Dispersal Sale, Shorthorn Herd.—The dispersal sale of the Grootfontein Shorthorn herd took place at Bloemfontein on the 13th May. The bull at the head of the herd, "Bromley Grand Duke," No. 1915, Vol. II, was sold for £90, and a 16-month young bull by "Squire," No. 1038, changed hands at £65.

The record price of £125 each was paid for "Grootfontein Girlie," No. 2708, Vol. I, and "Grootfontein Maudie," No. 5358, Vol. V. Prices for heifers of all ages varied from £15 to £52. 10s.

The results of the sale were considered very satisfactory, the average price for the whole herd being £32. 3s. 4d.

Annual Wool Congress.—The Second Annual Wool Congress held at Middelburg on the 26th and 27th May last, marked a further advance in the history of the organization of this important industry.

The opening address of the Chairman, Lieut.-Col. G. N. Williams, the Under-Secretary for Agriculture, dealt particularly with recent developments in the Department of Agriculture, in the creation of new Divisions for Field and Animal Husbandry, Economics and Markets, and Extension, with a view to assisting the farming community to develop along scientific and business lines. He also foreshadowed special research work in sheep diseases at the Grootfontein School of Agriculture at no very distant date.

Many important matters were discussed at the conference, which was attended by trade representatives from Durban, East London, and Port Elizabeth, also delegates from the Transvaal Sheep Farmers' Association and various wool growers' associations in the Orange Free State and Cape Province. An outstanding feature of the excellent spirit which prevailed throughout the discussions was the obvious desire on the part of trade representatives to understand and meet the farmers' requirements, particularly in putting up to public auction at least once all classified clips. The farmers in congress fully appreciated the attitude of the trade delegates, and there is indication of hearty co-operation between producer and distributor, without which development on sound economic lines is impossible.

An important achievement of the conference was the creation of a temporary Central Executive to arrange for future meetings and submit to the next conference a draft constitution for a central organization to organize and watch over the interests of the sheep and wool industry of the Union. This should fill a long-felt want and help to further stabilize the industry. There is, unfortunately, still a deplorable lack of interest in some quarters, and it is regretted that some of the wool growers' associations did not send representatives to the conference. It is hoped that greater interest will be shown in next year's conference and the wool competitions to be arranged for during the next wool season.

Refresher Course to Sheep and Wool Officers.—All the Sheep and Wool Officers of the Department attended the annual Wool Growers' Conference on the 26th and 27th May. Following it a refresher course was held. An address was given by Mr. Thornton, Director of Field and Animal Husbandry; the economic position of the sheep and wool industry was discussed by A. P. v. d. Post, of the Division of Economics and Markets; Mr. S. van Rensburg, Lecturer in Veterinary Science, Grootfontein School of Agriculture, gave a résumé of the more important diseases of sheep with particular reference to the recent discoveries in connexion therewith; the food problem in relation to sheep was introduced by Mr. A. Stead, Chief of the Soil Survey Section of the Division of Chemistry; Professor Duerden, of the Rhodes University College, Grahamstown, presented a résumé of a certain phase of the many problems of the sheep and wool industry that he has been so successfully investigating; a popular lecture on the spinning properties of various types and wool and conditions affecting same was given by Mr. G. S. Maré, of the Grootfontein School of Agriculture; and Mr. A. Marais, also of Grootfontein, discussed the various classes of sheep dips, with particular reference to their preparation and action under varied conditions.

Owing to the keen interest taken in these subjects and the ensuing discussion, little time remained to deal with the experimental work that is being conducted at the various Schools. These experiments, about thirty in number, were briefly introduced by the various officers concerned.

It was decided to hold a refresher course annually.

Pruning Notes.—Many pruning demonstrations will be given this year during the winter months at various centres to meet the requirements of fruit growers. Large numbers of deciduous fruit trees are being planted in the area served by this Institution, particularly apple and apricot trees. In many parts these trees are doing particularly well, the young apricot trees having grown at a remarkably rapid rate. It is, therefore, of great importance that the subject of pruning should receive careful attention to enable the growers to prune their trees on the right lines and to build up a strong framework for the mature tree. This can only be done satisfactorily by using correct methods of pruning from the beginning. Such treatment is particularly necessary in the case of the apricot, the wood of which is very brittle, and if not properly shaped to strengthen the limbs, the trees are very liable to suffer damage from strong winds or storms through having some of the branches broken, when laden with fruit.

The length of time available for pruning varies in the different parts of the area owing to the varied climatic conditions, but most of the pruning takes place in July. The necessity for correctly pruning the young fruit trees cannot be too strongly stated. For various reasons young trees are sometimes left unpruned or insufficiently pruned for a year or two, which means that when the pruning does take place, a considerable amount of the growth has to be sacrificed to try to get the trees into a proper condition.

GLEN, ORANGE FREE STATE.

Poultry Tests.—Certain tests, etc., in poultry-keeping, conducted at this Institution, were concluded at the end of April last, and details thereof will be published in due course. They were: (1) An experiment to arrive at the cost of production of eggs on the wet and dry methods of feeding poultry on a commercial scale; (2) a test to arrive at the average cost of the gross and net return, and details of expenditure and charges in connexion with marketing the eggs from one hundred White Leghorn hens kept under farm conditions and marketed as "guaranteed" eggs from the farm; (3) a single pen testing of thirty-six White Leghorns, eighteen Rhode Island Reds, and eighteen Austro Orps for breeding purposes over a period of forty-eight weeks; (4) a six-hen (White Leghorns) test in a small intensive house 4 ft. 6 in. by 6 ft., for the fourth year of the birds' lives. The result of (4) was sufficiently satisfactory to cause the birds being tested for another year.

The breeding experiment in connexion with them having been satisfactory in regard to fertility, hatching, and chicks reared, six pullets were started off in a similar house to test their producing capabilities as against those of their mothers in their pullet year.

Orchard Notes for the Orange Free State.—Owing to the continuous and late rains, leaves are remaining on fruit trees in this Province longer than usual. This will delay pruning operations, but will no doubt otherwise be beneficial. There is every indication at present of a short winter, to be followed by an early spring, and with the further probability of the danger of frost nipping the early blossoms. The soil is fairly moist at present, and it is advisable to keep the surface well cultivated so as to retain this moisture for spring growth and to give the trees a good start.

The late rains have also caused the growth of wood to continue longer than usual, with the result that there is now considerable immature wood which does not stand the winter well. In heavy soils this will have a tendency to retard the flowering of fruit trees, and it will certainly minimize the danger of the blossoms becoming nipped by frost.

Preventive Measures.—Do not irrigate on a light soil if the district is subject to late frosts, as this tends to bring the trees on earlier. On a heavy soil the opposite effect is likely to be obtained, irrigation tending to retard growth.

This year, especially, trees should be pruned fairly late in winter, since this will assist in retarding growth.

All broken branches, loose bark, and other places that will harbour insects should be removed. All large cuts should, after pruning, be painted over and not left till the leaves start to come on the trees; it will only increase the congestion of work in a busy time, and it is best to keep ahead with the work in the orchard.

The trees should be sprayed with lime-sulphur or bordeaux mixture. Besides acting as a preventive for insect pests and fungoid diseases, it will certainly retard growth by holding the buds together.

In suitable orchards, with good windbreaks or good wind protection, growers should prepare fuel for smoke screens for next month, as almonds will be coming into blossom.

Essentials of Good Milking.—Milking is an important operation on the dairy farm; unfortunately it is also one which is frequently neglected. With good dairy cows it is worth while using them to the best advantage by securing all the milk they are able to yield.

The following are essentials of good milking: It should be carried out quickly, quietly, and thoroughly; the manipulations should be uniform and continuous until all the milk is withdrawn. If the operation is carried out rapidly, the flow appears to be increased. It is also very necessary to do the milking quietly. Any undue noise or excitement tends to decrease the yield.

Then there is thoroughness. Since the last milk is the richest it should all be withdrawn. Unless all the milk is drawn off, the yield diminishes.

The hands of the milker should, of course, be dry. A little vaseline or similar lubricant may be used. The wet method is not only very unclean, but the teats also chap when left wet, especially in the winter time.

CEDARA, NATAL.

Improvement of Veld.—Considerable interest has been recently shown in this area regarding the fertilizing of natural grass veld. The question arises as to what extent is this justifiable under present conditions.

The following experiment has now been in progress for two years at the Cedara School of Agriculture in order to obtain information on the effect of fertilizing (chiefly phosphatic) on the yield, chemical composition of the herbage, and botanical composition of "rooigras" sour veld:—

No. of Plot.	Treatment per Acre per Annum.	Yield of Hay per Acre.	
		28th Feb., 1924.	30th April, 1925.
		lb.	lb.
1	100 lb. Superphosphate	3.415	3.100
2	100 lb. Ephos	3,410	3.066
3	100 lb. Basic Slag...	3,340	2,950
4	Control—no treatment	3,160	2,785
5	100 lb. Guano	3.565	3,250
6	100 lb. Bone-meal	3,385	3,235
7	100 lb. Bone-meal plus 100 lb. Guano ...	3,830	3,415
8	100 lb. Bone-meal plus 100 lb. Guano plus 500 lb. Agricultural Lime ...	3,395	3,400
9	Control—no treatment	3,045	2,665
10	500 lb. Agricultural Lime	—	2,600

The difference in yield due to fertilizing seems quite appreciable, especially where nitrogen has been applied, but not sufficient to justify the expense involved.

Chemical Composition of Herbage.—Five samples of "rooigras" (*Themeda triandra*) were taken from each plot and analyses made of each sample. No appreciable differences in the composition were recorded at the end of the first season. The herbage at the conclusion of the second season from the fertilized plots contained an appreciably higher percentage (approximately 75 per cent.) P_2O_5. It is interesting to note, however, that the percentage of P_2O_5 in the herbage from the fertilized plots in the 1924-25 season is considerably lower than the percentage of P_2O_5 in the herbage from any of the plots the previous season. The difference is apparently due to the abnormal season, and can, perhaps, partly explain the very general complaint of the inferiority of the grazing this past season.

Analyses of Samples.

Mean of Five Samples.	1st February, 1924.		24th April, 1925.	
	Plot 4 (Control).	Plot 8 (Fertilized).	Plot 4 (Control).	Plot 8 (Fertilized).
	Percentage.	Percentage.	Percentage.	Percentage.
Crude Protein	5·39	5·72	3·84	3·93
Crude Fat	2·52	2·38	2·56	2·62
Soluble Carbohydrates	48·17	47·72	52·52	52·38
Crude Fibre	39·54	39·28	34·83	34·85
Ash	4·39	4·90	6·24	6.22
Nutritive Value	67·9	67·9	68·6	68·8
Nutritive Ratio	10·1	9·4	15·2	14·9
P_2O_5	0·21	0·20	0·076	0·127

Botanical Composition.—No appreciable changes have made an appearance.

N.B.—The grazing factor has been omitted in this experiment, but will be included as soon as it can be conveniently done.

Winter Feeding of Dairy Cows.—Many so-called dairy cows are such poor producers that they do not pay to feed during the winter months. Cows of this common type do their best under conditions of summer dairying. If calved in the spring and made to rèly on the veld alone they often give fair returns. They will not, however, pay for winter feeding.

A good cow, however, is a most profitable user of winter feed. An excellent winter ration for a two to three gallon cow is mealie silage and a legume hay, such as cowpea, lucerne, or soya bean. On a ration of this kind it will produce about its maximum milk flow without any grain at all. Heavier producers, say, three to four gallon cows, will need the addition of 3 to 6 lb. of mealie meal per day.

Where a legume hay cannot be grown, and only grass hay is available, any cow producing over two gallons of milk should receive a grain ration. In this case some protein cake should be bought to supplement the other feeds. Good protein concentrates are linseed-meal, monkey-nut cake, cotton-seed meal. One part of any of these to three of mealie meal makes a good grain mixture.

Silage is a wonderful milk producer in the winter months. Its place can be taken by roots, melons, or pumpkins. A good deal more of these feeds will, however, have to be used to produce the same results.

POTCHEFSTROOM, TRANSVAAL.

Field-work.—Although July may be considered a slack month on the farm as far as field-work is concerned, there are nevertheless several things to be done which are important at this time of the year. In many localities harvesting and threshing of maize and selection of seed maize will be given attention this month. Closely connected with the question of harvesting of maize is that of the early preparation of the seed-bed.

This year the harvesting of maize and also winter ploughing are delayed on account of late rains. The soil, however, will be in excellent condition for winter ploughing, and this should proceed apace during July. Among the many advantages winter ploughing offers are a thorough preparation of the seed-bed, maximum penetration of spring rains, early plantings, and a more readily available supply of plant-food. Furthermore, winter ploughing helps to control or reduce the damage caused by cutworms and the stalk-borer and aids in the eradication of such weeds as bindweed and kweekgras. Every farmer, therefore, and maize farmers in particular, should seriously consider winter ploughing and the early and thorough preparation of the seed-bed.

Where maize has not been cut and stooked, the practice of cutting off the stalks after harvesting the ears will often be found a profitable and valuable one. Besides allowing winter ploughing to be commenced at once, the stalks, leaves, and husks may be stacked and stored until they are needed most—say, in August and September. There is also less waste, as the stalks may be fed carefully, instead of being wasted by allowing animals to graze them off in the lands.

Another profitable winter practice is the selecting and testing of seed maize. The testing is usually done later on in the season, but preparations for testing the seed maize selected may be made at this time. Information on the construction and use of ready-made appliances for the testing of seed maize may be obtained from the various Schools of Agriculture.

Planting of wheat will be delayed in many areas, and farmers will be forced to plant in July. In this case early varieties, such as Gluyas Early, should be sown and a liberal application of superphosphate given—say, up to 300 lb. per acre—to hasten the maturing of the crop. In the case of late plantings, a somewhat thicker rate of seeding than the normal rate should be used.

Inter-School Butter-making Competition.—At the last Witwatersrand Show an inter-school butter-making competition between the teams of the Agricultural Schools—Elsenburg, Cedara, Glen, and Potchefstroom—took place for the first time. As a prize a large 50 guineas silver cup was presented to the winning team by Mr. H. B. Papenfus, K.C., M.L.A., of Parktown. This year the prize was secured by the students of this Institution. The judge, reporting on the winning team, stated:—"There was a good deal of uniformity about the work of the Potchefstroom team and they showed a better appreciation of the finer points of competition butter-making than any of the other teams."

Calving Time for Stud Cattle of the Beef Breeds.—At this Institution it has been customary to put the bull with the herd at the beginning of December so that the cows commence calving from the beginning of September. The bull is taken out again at the end of February to avoid cows calving during the summer months—December, January, and February—the latter two of which are not considered good months to have young calves arriving. Through late and bad seasons it has been found that many cows will miss taking the bull in the summer months and for this reason it has latterly been the practice to leave the bulls with herds up to the end of March. It has also been the practice for many years to put the bulls of the beef breeds with the cows for about four weeks from the middle of June to the middle of July, in order to have cows served which, owing to suckling calves in the summer or the bad season or both, did not take the bull. The experience of late years has definitely pointed to the advisability of extending the winter service period well into August, especially in the case of the imported breeds. As a result calves will arrive from a certain percentage of cows during the autumn months, March to May. These autumn calves have been found to grow out well and are singularly healthy. The success of the system, however, depends on the provision on the part of the breeder of a sufficiency of succulent feed for the cows.

No hard and fast rules should be laid down as to the best season for calving, but generally the Institution's experience has been that the spring months, October, November and early December are the best and most practicable times for the majority of the breeding herd to calve down, and in the case of stud herds, where feeding of silage or grazing of cultivated crops is practicable, a certain number of autumn calves are very desirable in order to ensure a high percentage of calves from a valuable herd. In many cases, as a result of a very poor summer season, the resulting spring calf crop is a very poor one and the stud breeder would be faced with serious losses had he not returned the bulls to the herds during that winter.

While we have found it necessary, in a bad year, to leave a herd bull with a ranching herd on through the autumn to ensure summer calves, this is not a practice which is desirable at the best of times and is to be avoided by stud-breeders.

The Demonstration Train in the Western Transvaal.—The Potchefstroom School of Agriculture was well represented on the tour of the agricultural demonstration train through the Western Transvaal from the 21st April to the 11th May. The Chemistry and Field Husbandry coaches were staffed for the whole trip by the school, Mr. T. D. Hall and Dr. J. J. Theron taking turns with the chemistry coach, while Mr. D. Moses was on duty in the Field Husbandry coach. The Animal Husbandry section was represented by Mr. T. A. du Toit (in charge of the sheep) and Dr. Schreuder and Mr. De Wal (in charge of the cattle and pigs). Mr. G. J. Bosman also spent a few days with the train, lecturing at the various centres on maize culture. Mr. A. S. Canham was on duty in the Veterinary coach for two days, and Mr. D. Deenik in the Dairy coach for one day.

Lucerne.—April and May are generally accepted as the best months of the year for sowing lucerne. Weeds are then dormant and the young lucerne can make sufficient growth before the heavy frosts of June, and be sufficiently advanced to stand up against the weeds of early spring. On clean lands, however, lucerne can be sown in July and August, but if sown then, it would be advisable to fertilize superphosphate at the rate of about 400 lb. per acre. Should the weeds appear to be getting the better stand, a mower should be run over it; this will give the lucerne a chance to get ahead and smother the weeds.

Irrigation of Established Crops.—From the middle of July established stands of lucerne can be irrigated. After this wetting, as soon as the ground will carry animals without treading holes in it, cultivation should commence. Only established lucerne lands should be cultivated. Stands under twelve months should only be lightly harrowed or left alone. It is advisable to cultivate up and down the field and follow with a zig-zag harrow to collect the grass pulled out by the cultivator; should the field be very grassy, cultivate cross-ways as well. Cultivation after each cutting is not advised and hardly practicable. However, lucerne should be cultivated thoroughly, at least once a year, preferably in July and August.

ELSENBURG, MULDERS VLEI.

Red Scale and Fusicladium Control in Pear Orchards.—The following is a summary of spray tests in the control of red scale and fusicladium carried out during the 1923-24 fruit season and repeated during the 1924-25 fruit season by the Entomologist:—

Home-made light engine-oil or lubricating-oil emulsion, diluted at the rate of one measure in fifteen measures of water, applied in late winter, but before buds opened, satisfactorily controlled severe infestations of red scale on Duchesse and Kieffer pears. It was more effective than scalecide diluted at the same rate, and much more effective than Harbas, diluted at the rate of one measure in twenty measures of water, as recommended on the label. Furthermore, the home-made emulsion used was more than twice as cheap as the proprietary miscible oils.

A Stock Emulsion.—The home-made oil emulsion tested is similar to the one now used for pernicious scale control in some parts of the United States. Directions for making it are as follows:—

Standard Oil No. 8 (or any lubricating oil of similar viscosity and specific gravity)	1 gallon.
Water	½ gallon.
H. & S. soft soap (or a potash fish-oil soap)	1 lb.

The oil, water, and soap are placed in a tank and heated until the contents come to a boil. A few minutes after the boiling begins, when the brown scum commences to disappear, the mixture should be removed from the fire, and all of it should be immediately vigorously pumped from the receptacle by means of a hand or bucket pump into another receptacle, and then pumped back again into the original receptacle. It is necessary to quickly pass the mixture

twice through the pump before cooling to satisfactorily emulsify. Before pumping, the cap and disk of the nozzle should be removed. The emulsified mixture is then placed in the spray tank and water slowly added to it, while it is being stirred, until fifteen gallons are added. The mixture should not be allowed to cool before it is passed twice through the bucket pump. Merely stirring the mixture will not produce a satisfactory emulsion.

Any fruit grower may easily make this emulsion, and it is recommended as a cheap and very effective late dormant spray when red scale is severe. Further details for making it on a large scale may be had on application to the Principal.

One application of Capex lime-sulphur, diluted 1-10 with calcium caseinate spreader, applied in late winter just before the buds opened, did not control red scale satisfactorily except on Beurre Hardy trees, which blossomed late and were not severely infested.

One application of Capex lime-sulphur, with or without spreader, diluted 1-10, applied just before the buds began to open, followed by another spray of lime-sulphur, diluted 1-75, plus spreader, applied when the blossom buds were pink, did not control red scale satisfactorily on Duchesse and Kieffer pears.

One application of Capex lime-sulphur, diluted 1-10, applied in late winter before the buds opened, and one spray of lime-sulphur of 1-50 or 1-60 dilution, with or without spreader, applied when blossom buds were pink, followed by two combination sprays of bordeaux and lead arsenate at the usual strength, applied for the first two codling sprays, satisfactorily controlled red scale and fusicladium on Louise Bonne pears, and fusicladium (but not red scale so well) on Forelle pears.

Capex lime-sulphur, diluted 1-10, applied in late winter, followed by one application of lime-sulphur diluted 1-50 or 1-60, plus spreader, when buds were pink, and two applications of lime-sulphur diluted 1-80, plus spreader, with lead arsenate, during the first two codling sprays, controlled well both red scale and fusicladium on Louise Bonne, and fusicladium, but not red scale satisfactorily, on Forelle. Very little burning of foliage resulted.

The unusually late rains and prolonged cool weather probably accounted for the less generally satisfactory control of red scale on the earlier blossoming varieties, e.g. Kieffer and Forelle, which required an earlier application of the dormant spray than the others.

The continued increase in infestation by pear mealy-bug may result in the near future in the necessary substitution of two or more cheap home-made lubricating oil sprays for the one dormant lime-sulphur spray. Extensive tests of various oil mixtures in the control of both red scale and pear mealy-bug will be made during the coming season.

Codling Moth in Apricots and its Control.—The following extracts, taken from a detailed report by Dr. Pettey, the first part of which is published in this issue of the *Journal*, should be of interest to apricot growers. The report covers the work of the 1924-25 fruit season.

Codling moth is a serious pest of apricots in many Wellington orchards, where practically no pear, apple, or quince orchards exist, and is gradually spreading. Kelsey and Wickson plums are also badly attacked.

The earliest codling eggs began to hatch about a month after Royal apricots and five to six weeks after the earliest blossoming varieties dropped their petals. The life-cycle of the earliest first brood insects occupied two and a half months. Over 90 per cent. of the first generation larvae which survive the summer heat wintered over and did not develop into moths. Consequently, it may be assumed that there is a very small second generation, and that there is practically a one-generation strain of codling moth in Wellington. This explains why codling is able to maintain itself year after year in apricot orchards.

Spraying thoroughly once, during the first week of October, with 1 lb. of acid lead arsenate powder in 40 gallons of lime water, with or without spreader, reduced codling infestation from 23 per cent. in unsprayed Royals of the Malan orchard and 6.6. per cent. in the Taylor orchard to about 2½ per cent. and 2 per cent. respectively, without causing burning of importance. Spraying *once* these mixtures, using 40 gallons of water in place of lime water, and spraying *twice*, with or without lime water, and with or without spreader in the mixture, resulted in better control, but caused serious burning to both fruit and foliage. New Castles were less susceptible to burning than Royals. The efficiency of one spray on this variety was considerably lessened this season by cracking of the skin, caused by wet weather. Nevertheless, one spray reduced the infestation from 22 per cent. in the unsprayed to 8 per cent. in the sprayed trees.

Nurseries in Quarantine at the 1st June, 1925.

Name.	Address.	Cause of Quarantine.	Extent of Quarantine.
J. W. Patrick	Newlands, C.P. ...	Circular Purple Scale	Palms and aspidistra, all.
R. Mason & Son ...	Pietermaritzburg	Red Scale ...	Lemon stocks.
W. A. Sturm	Craighall, Johannesburg	Crown-gall and Root-gall Worm	Deciduous, all.
Rud. Schwartz ...	Johannesburg ...	Pernicious Scale...	Roses, all.
Sunnyside Farm ...	Louis Trichardt...	Red Scale ...	Citrus, all.
D. J. Conradie & Bros.	Robertson, C.P. ...	Red Scale ...	Citrus, all.
T. Kohler	Simondium, C.P.	Red Scale ...	Citrus, part; Deciduous, part.
J. Cillie	Zuider Paarl ...	Red Scale ...	Citrus, part.
A. S. Strydom & Co. ...	Krakeel River ...	Woolly Aphis ...	Deciduous, part.
Craighall Estate Nursery	Craighall, Johannesburg	Pernicious Scale...	Deciduous, all.
A. P. Maskell, ...	Johannesburg ...	Pernicious Scale...	Deciduous, part; Roses, all.
G. J. Labuschagne ...	Groot Marico ...	Red Scale ...	Citrus, all.

THE GREAT DROUGHT PROBLEM OF SOUTH AFRICA.

I.—An Accumulative Evil.

Introduction.—In September, 1920, the Government appointed a Commission to inquire into the best means of avoiding losses by drought, and, based on considerable investigation which necessitated travelling over a large area of the country, the Commission presented its report * in October, 1923. In April, 1922, however, it presented an interim report (now incorporated in the main one) dealing chiefly with the position of the small stock farmer, and the following chapter gives an outline of the very important findings of the Commission on this part of its investigations. While subsequent chapters will deal more specifically with the various phases of the subject, the present one goes directly to the root of the trouble, and at the outset must in its appeal arrest the attention of every South African. The interim report is of the utmost moment to small stock farmers and, indeed, to every inhabitant of the country, for it discloses conditions that gravely concern the welfare of all and are a serious menace to posterity. In introducing it, the Commission states that two points seem firmly established; firstly, that a large portion of South Africa was dry long before the white man arrived, as evidenced by the name "Karroo" and by the highly specialized drought-resisting flora of that region; and secondly, that since the white man has been in South Africa enormous tracts of country have been entirely or partially denuded of their original vegetation, with the result that rivers, vleis, and water holes described by old travellers have dried up or disappeared.

This drying out is still proceeding with alarming rapidity, and the following extract from the report, written deliberately and in full knowledge of its significance, reveals, as nothing else can, the fate that awaits the country with a continuance of present conditions:—"It is unnecessary for your Commission to vie with the several writers who have, at various times, with facile pen depicted the gloomy and ghastly future which lies before our country. . . . The simple unadorned truth is sufficiently terrifying without the assistance of rhetoric. *The logical outcome of it all is 'The Great South African Desert' uninhabitable by man.*" And the main causes of drought losses and the cumulative evils that they entail are the kraaling of stock, occasioned mainly by the jackal, inadequacy of the drinking water facilities, the destruction of vegetation resulting in soil erosion, which in turn leads to a diminishing efficiency of the rainfall.

* Final Report of the Drought Investigation Commission. Obtainable from the Government Printer, Pretoria. Price 12s. 6d. This Report includes the Interim Report which was published in April, 1922.

Rainfall.—When seeking the cause of the ever-recurring droughts, periods when natural veld grazing has become so scarce, and the supply of water at the drinking places so diminished, that loss of stock results, the question of rainfall is of first consideration. And no evidence has been brought forward to prove that the average rainfall in South Africa has changed during recent historic times. Variations occur and there are good and bad years, but there is no definite tendency traceable of either an upward or downward direction. Personal reminiscence is misleading: there are many people who assert that the nature of the rainfall has altered and that the gentle, soaking, and regular rains of yore are giving way to innumerable small and useless showers or to violent and devastating thunderstorms. Be this as it may, it must be conceded that the rains of the past generation fell on unbroken, under-stocked grazing lands, and were more lasting in their beneficial results than rains of equal magnitude falling to-day on veld overstocked, tramped out, semi-waterproof, hard-baked by sun and veld fires. Herein, indeed, lies the kernel of the drought problem: while the quantity of rainfall received shows little variation, its *utility* has certainly diminished, for the quantity that is absorbed by the soil is continuously decreasing, and for this alarming condition man is responsible.

Kraaling of Stock.—South Africa is essentially a pastoral country, the greatest portion of it being devoted to animal husbandry, and as a general rule all live stock are dependent for their sustenance on the natural veld herbage. And it is over the areas where small stock farming is practised that the effects of drought are most severe, so that it is from this quarter the causes are to be sought. Most farmers kraal or concentrate their small stock at night at certain fixed places, due largely as a protection against the depredations of the jackal. But the animal that is kraaled leads an unnatural life. Left to itself, the sheep grazes during the early morning and late afternoon, rests during the heat of the day, and sleeps through the night. To-day he is driven to and from his kraal to pasturage at a time when he should be browsing, and as good pasturage recedes further and further from the vicinity of the kraal, particularly as the winter progresses, so has the unfortunate sheep to spend more and more of his proper feeding time in journeying to the distant veld. Then the exertion entailed by these journeys increases the animal's food requirements, and this extra need during seasons of scarcity is often just the deciding factor that results in death: for the free ranging sheep is better able to sustain life (by drawing on the reserves of fat and flesh of its own body), being able to live several weeks without food, provided it has sufficient water and also the proper rest that the driven sheep is denied. Thus the kraaled sheep has not the same chance to acquire robustness as the free one. This affects the value of the wool, as do also other kraal-induced evils, such as scab. Evidence shows that where sheep run day and night in suitable paddocks losses are rare, for they are able to find whatever fodder remains on the veld and so postpone the call on their body reserves to the latest moment, whereas the kraaled sheep, denied the opportunity of foraging at will, succumbs. The abandonment of the kraaling system is a necessary step in the reduction of drought losses.

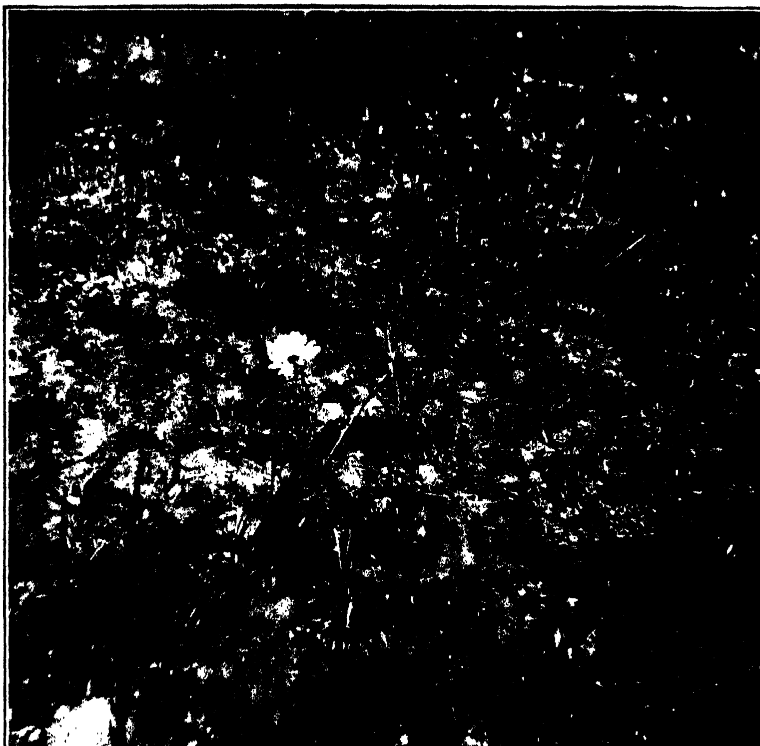
Overstocking.—It is extremely difficult to decide upon the number of stock a farm can carry from year to year, for the rainfall, which

determines the amount of grazing produced, varies tremendously from season to season. There are other factors also that have to be considered, and taken together they present such variations that a particular farm may carry double the number of stock in some seasons that it can in others. Stocking a farm is therefore speculative, especially as (which is, unfortunately, the practice) no provision is made for feeding stuffs in the event of a bad season. It is naturally the intention of the farmer to make the most use of his veld, and as a result it is frequently overstocked: indeed, the practice of overstocking farms is very prevalent throughout the Union, due to several causes, among which are extreme seasonal variations and the optimism of the farmer. This leads to overgrazing, which compels an increased movement of stock, as they have to forage over a wider area to obtain their food requirements; this again tends to the trampling out of the veld, and demands the extra energy and thus the greater food requirement of the animal. Animals on such a farm are not in the same condition to meet a drought as are those on farms carrying less stock. But above all, overgrazing results in the denudation of the vegetal covering of the veld, and is the source of many ever-increasing evils.

Water Supply.—It is found that on many farms the number of watering places is insufficient, and further that, generally, watering places are not kept sufficiently clean, and thereby impair the health of the animals using them. Moreover, the consequent need to drive stock long distances to watering places has the same evil consequences as sending them from the kraal to the distant veld for pasturage. An animal can live for several weeks without food by drawing on the reserves of food stored in its body, but it has practically no reserve of water. For the functioning of its body water is essential, and moreover, as the drought proceeds, the animal requires an increased supply of water to enable it to digest and dispose of the dry, fibrous matter obtained from the veld at such times. But at such time water is scarce and many animals die, while the stock are congregated around the watering places, regardless of the food supply surrounding them. Water is the essential of life, and the provision of adequate supplies of it is a prime necessity in fighting droughts. In every way possible the farmer should improve the water resources of his farm, and so be equipped very materially to fight drought.

Deterioration of the Veld.—It is of vital importance that the vegetal covering of the country should not be impaired, for from it not only does the animal obtain its sustenance, but in its absence the rainfall runs off easily, its efficiency is diminished, and the soil is eroded. The congregating of stock, as practised at present, leads to much destruction of the vegetation by trampling and overgrazing. A characteristic of areas of low or intermittent rainfall is the high proportion of perennials in its vegetation, a provision of nature, in that having established a well-developed root system, they are able to make the fullest use of the rain when it comes, and are in vigorous growth before the annuals have had time to germinate. Perennials under natural conditions are thus able to thrive with a scanty rainfall, and also to repress and mask the existence of the annuals. Destroy the perennials and the annuals will have all the rainfall and become increasingly prominent, but will more readily die, for, unlike the former, which are able to go into a resting condition between rains, annuals need a sufficiently moist soil to make growth continuous.

Veld composed of annuals therefore is less certain of being able to carry its quota of stock throughout the year. Yet, on an overgrazed veld, perennials, which spring into edible growth first, are eaten down before they are able to manufacture their full reserve food requirements, and if this process is continued the plant dies. Palatability also plays its part, so that the perennials the animal most likes are first eaten, and gradually they disappear from the veld until in overgrazed parts the surviving plants are those of an undesirable and uncertain type.



[*Photo by E. P. P.*

AT GROENKLOOF, NEAR PRETORIA.

Dimorphotheca spectabilis (a poisonous plant) appearing as one of the first green plants on burnt veld. It is at this time that stock will eat almost anything green and often with fatal results.

Overgrazing is most detrimental to the veld when growth is most active, for instance, after a drought breaks, for this rapid growth after plenteous rain determines not only how much fodder there will be for the coming dry period, but also the amount of storage of rootstock bud, and seed, and through this the yield of fodder in the coming year. Thorough grazing subsequent to this period is not so exhaustive. Investigations in America show that by reducing the number of stock during the main grazing season (which is not possible on the overstocked, unpaddocked farm) to about half the average

number the range can carry for the year, thereafter grazing fully for the remainder of the year (eight months), the range so treated improved as much as similar ranges protected for the whole year. So with the valuable Karroo fodder plant, the "skaap bos," it is evident that resting is necessary, and that nothing is more harmful than overgrazing at its period of active growth.

When a farm is divided into camps and the grazing can be regulated, the animals will be compelled to eat all the veld growths that are not harmful, notwithstanding their degree of palatability, so that all useful plants get an equal chance when the camp, in the course of rotation, is rested. Where this is not practised the stock naturally confine their choice to the most palatable shrubs, leading to their destruction and the spread of the less palatable ones.

The farmer should therefore endeavour to reduce intensive grazing at this period, and this can be done if his farm is divided into paddocks,* for such a sub-division permits of the best possible distribution of the stock over the farm and allows of absolute rest for paddocks that require it.

Reserves of fodder for use when grazing is scarce are very valuable, not only for keeping stock alive, but also for preventing overgrazing at the critical time when vegetal growth is very active. Even if no permanent damage is done, overgrazing at the period of active growth seriously diminishes the following yield of fodder.

The chief causes therefore of the daily deterioration of the veld are kraaling, scarcity of suitable watering places, and overgrazing. And this deterioration in itself induces accelerated speed in its career of damage by resulting in the ever-growing need for greater movement of stock to find food and water, leading to overgrazing and the mechanical destruction of the veld, first the palatable perennial and finally the remaining herbage. Then comes the culminating evil—the diminishing efficiency of the rainfall. As the vegetal covering becomes scanty, so is the run-off of the rainfall accelerated, and less water becomes available for plant requirements, a serious matter when water is the limiting factor in such plant growth. Just as serious also is the increased evaporation that ensues, due to lack of the protection the otherwise closely growing herbage would have afforded, which also robs the plant of the moisture it requires. And so as the veld is denuded of its covering, the loss of moisture due to increasing run-off and evaporation may become so rapid that in time the total amount of rainfall that is made available is so scanty as to be insufficient to support the original vegetation. When that time arrives rapid deterioration sets in.

Soil Erosion.—The processes outlined above that are leading to the destruction of the country's natural herbage and to periodic drought losses also lead to soil erosion. There is erosion of cultivated lands, a matter of extreme importance, as well as of the veld soil, but the Commission confines itself to the latter, pointing out that the soil of South Africa is being rapidly eroded (*a*) by surface erosion by wind, (*b*) by surface erosion by water, and (*c*) by donga or sloot formation. The surface erosion is the most dangerous, insidiously eating away

* Mr. Arthur Stead, a member of the Commission, has elaborated on this system of sheep-farming in an article ertitled "The Value of the Paddock System," published in the August, 1921, number of the *Journal.*

the soil of the Union, which is a *definitely limited and irreplaceable quantity*. This being so, we are morally and economically bound to conserve it. Erosion by slooting is always evident, while surface erosion frequently takes place without being easily noticed, but by removing great layers of the country's most valuable soil and plant-food, it is causing enormous loss. The wind is similar in its action, removing first the rich surface soil which has taken centuries to form. Sometimes it bodily removes ploughed fields, but the greatest damage is caused by the strong dust-bearing winds that sweep the country. While water carries the eroded material direct to the sea, the wind may carry it in all directions, yet its ultimate destination is in the direction of the prevailing wind of the dry season.

In addition to surface erosion, and greatly assisted by it, proceeds the slooting of the country, that is, the cutting up of the veld by runlet and gulleys, eventually forming the deep water-courses known as sloots or dongas, which remove both soil and water. The gradual deepening of these sloots increases the gradient of the surface water on its banks, and innumerable branch sloots eat their way back from the banks, and in this manner all the surface soil is eventually removed in the vicinity of sloots, and the resultant bareness produces an increased run-off. The latter running into the sloots aids in the undercutting of their banks, increasing the size and multiplying the number of the sloots. Thus the damage is cumulative, and so it proceeds each year.

Water which should have soaked into the ground to feed plants and replenish the underground supply is carried to the sea, and in eroded areas, badly slooted, the level of the water-table is continually receding, constituting an economic loss, as the sinking of the water-table connotes greater labour in making available underground supplies. The ever-increasing sloots, with their accelerating run-off, result in river floods, which may be expected to increase in severity with the years, but decrease in time of flow, while periods of no flow will naturally become proportionately longer.

In this way irrigation enterprise, on which the country so greatly depends, is hampered, frequently being made uneconomic owing to the costly protective and other works needed to cope with high and low floods, and as a consequence increasing the cost of producing food-stuffs in this country. The remedial measure recommended is to build reservoirs for the purpose of regulating the flow, but the silt brought down reduces the useful life of the reservoir and adds to the cost of the scheme. There are parts where the silt carried down by rivers is useful, but this is not always the case, as in some instances the very fine silt chokes or suffocates plant growth, so that its presence in water renders it unfit for irrigation, while in many other cases coarse material brought down kills off all vegetation. But the greater portion of the silt finds its way, unused, to the sea.

The erosive power of water is enormously increased by concentration and increased velocity which are brought about by such factors as climate, temperature, humidity of the air, the annual rainfall and its intensity, composition of the soil, its situation, prevailing winds, etc. A big controlling factor is the amount of vegetable covering by which the soil is protected. When left to herself, *Nature* arranges a state of balance between the various factors. When *Man* arrives and upsets the balance by destruction of the vegetation, trouble results.

And in the latter respect the small stock farmer, by his wasteful system of veld management, is an outstanding cause of erosion, for his present system of grazing is detrimental to stock, vegetation, and veld. Soil erosion is causing also a marked decrease in the underground water supply of the Union, and thereby increases the difficulty of watering stock.

Happily, the interdependence of the factors that lead to the present position enables the employment of one remedy, viz., improved methods of veld management, by which the evil effects of all can simultaneously be remedied. This is as necessary for the welfare of future generations of the Union as for the saving of the flocks and herds now grazing on our veld.

Improvement of Farming Methods and Conditions.—While the present system of small stock farming is leading to such serious damage, evidence shows that by the adoption of the principle of free ranging an increase of 75 per cent. was carried on a certain farm without damage to the veld, which, on the contrary, actually improved. Other farmers have had similar experience. Yet the present system is continued because of the presence of the jackal, which necessitates kraaling; the scarcity of natural water supply for the drinking places which must be provided in every camp if paddocking is adopted; the want of capital required to erect the necessary jackal-proof and other fencing, and to provide water for the paddocks; the presence of roads—many of them unnecessary—which make the lay-out of a suitable scheme of paddocking extremely difficult, or indeed impossible; and custom and the lack of a full realization, on the one hand, of the evil results of the veld deterioration and soil erosion caused by present methods and, on the other, of the advantages of the new system.

In order to rectify the present position many have advocated direct legislation, stringently administered. The Commission states that, first and foremost, the State is bound to take action in connexion with soil erosion which, if persisted in, will lead to national suicide. But the individual also, who has brought the damage, has his responsibilities, and without his co-operation the damage cannot be repaired, for prevention and sustained vigilance are essential, and no State organization can ever supply the minute watchfulness needed. Therefore the Commission does not consider the time ripe for direct legislation; education of public opinion is first required, and thereafter direct legislation is necessary. To awaken the community to its danger, sustained propaganda is necessary, particularly that class of instruction natural to the sheep and wool experts of the Department of Agriculture, while instruction on soil conservation should occupy a place in the curriculum of every educational institution in the country.

Recommendations.—Having arrived at the above conclusions, founded on the solid support of practical experience corroborated by scientific analysis, the Commission recommends the Government to do its utmost to abolish the kraaling system and make it as easy as possible for the farmer to put the paddock system into practice. To effect this, the jackal must be exterminated, provision must be made for the supply of cheap fencing material, and the water supply for stock must be developed. In dealing with these matters, organization

of the farmer is the first essential, while the State has to assume certain responsibilities in the control of soil erosion, and the Department of Agriculture has to investigate certain grazing and fodder problems.

The train of consequences following the system of farming now in vogue due to the presence of the jackal has been described. The animal is a dangerous menace to the State and must be exterminated. This is necessary in order to enable the adoption of the new system of farming needful to stay the processes that now operate to the detriment of all. To the farmer, extermination of the jackal means large savings in the cost of herding his flocks, more and better wool, greater freedom from stock disease and insect pests, greater protection against scab, and an increased capacity of the farm to carry stock. To the whole community it will lead to the recovery of the country's vegetal covering and the staying of soil erosion.

To put into practice the system of paddocking and to erect ordinary and jackal-proof fencing will entail considerable outlay, but the need is so imperative that the Commission recommends that fencing loans be granted by the State to farmers on the best possible terms. It is pointed out that, among its many advantages, fencing will, by protection during initial growth, lead to the planting of trees on the veld so useful for the shelter and well-being of stock, and will also permit more extensive planting of spineless cactus, a valuable standby in times of drought.

Too little attention is given to the adequacy of watering places and to their cleanliness, and stock have generally to be driven long distances to obtain water, the disadvantages of which have already been mentioned, and farmers should improve their facilities for watering stock in every way possible.

The above recommendations, it will be observed, imply direct action by the State, and this phase will be dealt with more fully in a subsequent chapter. Enough has been said, however, to show vividly the need for immediate action by the farmer, and how he should proceed to rectify the present unhappy and dangerous position he finds himself in. And let it now be said in the plainest terms that, while the State is doing much, and will undoubtedly use all its resources in combating the evil that is in our midst, this evil has been brought on us by the individual farmer, and he continues moreover in methods that will lead to a disastrous end. Therefore with him rests the first and last responsibility. He cannot evade it by waiting for some direct action by the State. He has been warned of the danger and shown the way of escape. If he still fails to bestir himself in an immediate and sustained effort to carry out his obligations on his own farm, he will be guilty of an offence, the degree of which no tribunal of his time can judge, for "the Earth is the Lord's, and the fulness thereof."

SOME EXPERIMENTS IN SOIL INOCULATION WITHIN THE UNION.

By C. F. JURITZ, M.A., D.Sc., F.I.C., Chief, Division of Chemistry.

BETWEEN ten and twelve years ago the late Professor Bottomley awakened a good deal of interest in a bacterial fertilizer, which, it was asserted, could be used for stimulating the growth of non-leguminous crops. This fertilizer was subjected to experimental trials in the field at Rothamsted Experimental Station, but the results were not promising, and interest accordingly waned. Since then a form of peat specially charged with a bacterial culture, has been applied as a fertilizer for various crops other than legumes, and in some cases, particularly with regard to potatoes, there have been reports of good results, but general experience has not up to the present supported the view that, apart from the known benefits conferred on the soil by the addition of humus, a bacterial fertilizer of the type indicated is capable of improving non-leguminous crops.

But if the use of bacterial fertilizers for plants other than legumes is unwarranted by experience, the question as to what extent such applications to the soil benefit leguminous crops has not yet had a full answer. The formation of nodules on the roots of legumes, such as peas, beans, clover, vetch, etc., is now a fact of common knowledge, and the nature of these nodules, as well as the acquisition of atmospheric nitrogen for the soil through the agency of leguminous plants, is also fully appreciated by scientific agriculturists. Nevertheless, the circumstances in which the application of what has often been called a "bacterial fertilizer" produces a marked beneficial effect on soil and crop are not always adequately understood, and hence experiments along those lines may occasionally be desirable, even if only for the purposes of positive or negative demonstration. A locality may be devoid of certain bacterial organisms, and for that reason may fail to bring to maturity crops for whose culture those particular organisms are essential, and the inoculation of the soil may in such event supply the deficiency. On the other hand, soil inoculation may possibly fail in producing any marked results for no other reason than that the special organisms added by the inoculation had already been active and working in that soil. Experiment has accordingly to be resorted to in many cases in order to reveal the true condition.

For this purpose it was felt in the Division of Chemistry, shortly after its reorganization a few years ago, that steps should be taken to test the condition in various parts of the Union as speedily as circumstances would permit, first of all in respect of bacteria already known to be associated with crops ordinarily cultivated, and in the second place, with regard to organisms produced from the nodules of indigenous plants. It is realized that a large number of leguminous plants do not produce nodules, but it is also generally recognized that

there are many leguminous nodule-bearing plants indigenous to South Africa, the organisms from which might possibly be of considerable value for some cultivated crops, and in this connexion it was resolved at a conference of Botanists held at Pretoria some two years ago, to afford the Division of Chemistry all possible assistance in relation to the inoculation of legumes, and to supply nodules from the indigenous plants available. This second phase of the investigation, perhaps the more interesting one, it has not yet been found feasible to undertake, but some experiments have been carried out with the commoner crops and organisms, and it is considered desirable to give the results of these the earliest possible publicity. There is all the more reason for this because the cultivation of various leguminous plants has been recommended by some of our Schools of Agriculture. It is therefore proposed to give an outline below of some of the experimental work hitherto carried on under the supervision of the laboratories in the different centres.

CAPETOWN.

As in most cases, bacterial cultures had to be imported from oversea, it was resolved at an early stage to undertake in the Capetown laboratory of the Division of Chemistry, the growing of pure bacterial cultures for the inoculation of soils and crops. This activity was supported by the conference of Botanists to which reference was made above, and also by an earlier conference of Agricultural Experimentalists which had adopted the following resolution; "That the control and distribution of legume bacteria be vested in the Division of Chemistry, in order that cultures already in the country may be distributed to all requiring them, and that provision be made for the importation of new types by the Division of Chemistry as the necessity arises. That until an efficient control be established, the conference deems it inadvisable to permit the distribution of imported or patented cultures through private enterprise." For the present the supply, although amply sufficient for all needs as far as quantity is concerned, is limited to only a few types, the original supplies having been procured partly from Europe, partly from the United States, and partly from sources within the Union.

The types of cultures kept in stock at present in the Capetown laboratories in pursuance of the above scheme, comprise the following varieties of *Bacillus radicicola,* the sources whence the original cultures were received in these laboratories being indicated in each case:—

1. Lucerne...	United States.
2. Peas	,,
3. Vetch	,,
4. Red clover	,,
5. Beans	,,
6. Soy beans	,,
7. Vetch	Potchefstroom.
8. Crimson red clover...	Elgin, Caledon.

The United States cultures were obtained from Professor S. F. Edwards, of the Edwards Laboratory, Lansing, Michigan. The Potchefstroom culture had been prepared at the local School of

Agriculture from material imported from abroad, and the crimson red clover organisms were prepared from red clover nodules personally collected on the farm of Messrs. Molteno Brothers, Elgin, Caledon Division, C.P.

Bacterial cultures were also imported from Great Britain, but through some mischance the tubes on arrival here were found to have dried out, and no results were obtained from their contents.

All the above eight varieties are continually kept alive in stock in the Capetown laboratories, the stocks being renewed periodically by the preparation of fresh cultures capable of being either supplied to farmers and other institutions, or for departmental experiments as occasion may require.

Caledon Division.—As indicated above, a visit of inspection was paid to Elgin, in the Caledon Division, in 1922, a locality where it was said clover at one time could not be grown. On that occasion crimson red clover was found growing very profusely, and formed in fact, a veritable carpet. The cause of the change was ascribed to the fact that Mr. Molteno had some ten years previously, after reading an article by Professor Bottomley on the subject, imported a supply of his bacterial cultures for clover, and inoculated the soil of his farm therewith. Mr. Molteno, at the time of my visit, still had some of the original packets, and on bringing one of them to the laboratory I was surprised to find that the organisms were still active and capable of reproduction. Nodules taken direct from the red clover growing at Elgin were also brought to the laboratory and examined, and showed the presence of typical *B. radicicola*. From the latter a pure culture was prepared which, as above stated, is being kept available for the purpose of inoculation as may at any time be needed.

Somerset West.—The Honourable J. W. Jagger, noting the success that had attended the inoculation of the Elgin lands, obtained some truck-loads of soil from Messrs. Molteno, and had them spread over his own lands at Lourensford, Somerset West, C.P. It was therefore determined to carry out experiments at Lourensford in order to ascertain to what extent the organisms had permeated the soil. It may at once be said that the final inspection, after conclusion of the experiments, showed considerable evidence of nodule formation on the plots which had *not* been inoculated for the special purpose of the experiments.

The general plan of the experiments whether at Lourensford or elsewhere was as follows:—An area of nearly half an acre in extent was divided into four equal plots. These four plots were thus treated, the culture used being No. 3 in the above list:—(1) Not inoculated but limed. (2) Both inoculated and limed. (3) Inoculated but not limed. (4) Neither inoculated nor limed. All four plots were sown with vetch, lucerne, clover, or other leguminous crop.

It may be well at this stage to anticipate the results of the series of experiments recorded in these pages by saying that, in many cases, we have found the uninoculated plots to give as good a crop return at the harvest as the inoculated, and in some cases the liming rather than the inoculation has produced whatever improvement was seen in the yield. The inference is that inoculation in such cases has been superfluous. Another frequent experience was that the nodules formed by *B. radicicola* on the roots of legumes were found on the roots of

plants grown on the uninoculated as well as on the inoculated plots, proving that the bacillus was present in both cases before inoculation.

In the south-western districts of the Union, however, there has apparently been something of a variation from this frequent experience, as the facts above related regarding Elgin demonstrate, and of all the inoculation experiments laid down in the Cape Province, few, if any, seemed so promising as those at Lourensford; some details of these may therefore be recorded.

On a large piece of hillside land under lucerne, over 12 acres in extent, four experimental plots were laid out on the 14th August, 1923, on the extreme upper border, and sown with lucerne, and a similar series of four on the lower border, each individual plot being one-tenth of an acre in extent. Fourteen weeks later the plots were inspected, but they were so overgrown with weeds that it was impossible to detect any difference in growth between the control plot and the others. Large numbers of young lucerne plants—between 150 and 200—from the field *outside* the experimental plots were examined at this stage, but in no instance was there a vestige of a nodule to be seen. This state of apparent deficiency in the soil had not, up to that time, been observed in any of the experiments in other localities, nodules—even though small ones—being invariably found. As far as the experimental plots themselves were concerned, examination confirmed what had already been noticed in the lucerne lands outside: the plants on the uninoculated plots had no nodules on their roots, but on the inoculated plots nodules were observed, and *the largest and most numerous nodules were found on the plots which had been both inoculated and limed.*

It seemed from the general appearance of the lucerne lands at large, that, although they had received agricultural lime at the rate of one ton per acre, they were so acid that considerably more lime was needed. There was a great profusion of "Steenbok zuuring" (*Rumex acetosella*), indicating excessive soil acidity, and it is well known that acid soils are distinctly unfavourable to the effective action of nitrogen-fixing soil bacteria.

Cape Division.—On the Government Wine Farm, Groot Constantia, early winter peas were found to produce nodules, whether inoculated or not, but here too the nodules were better developed where agricultural lime had been applied. Lupins and vetches on uninoculated soil likewise exhibited vigorous nodule formation. The plots had been set out along lines similar to those employed at Lourensford, except that the entire series of plots had been manured with Government guano, and while the plots experimented on with winter peas had grown beans and peas from time to time, those assigned to the vetch experiment had grown vines for twenty years and had received various fertilizers during that period. Four months after sowing the experimental plots the following notes were made:—(1) As regards the vetch experiment, it was found that plants taken from different points on the plots exhibited vigorous nodule formation, but, owing to oats having been sown along with the vetch, it was not possible to judge the relative growth, on broadly comparing plot with plot. (2) With reference to the early winter peas, it was seen that on the plots that had been limed, and those where the seed had been inoculated, the plants appeared to be in better condition than on the plots where there had not been any liming or inoculation. Owing to

farm exigencies at Constantia, the peas were picked by the farm hands, when green, so that comparative harvest returns were not available. It was observed, however, that the nodules on the roots were much better developed in the case of plots where lime had been applied. Examination of several plants taken from widely separated parts of the uninoculated plot showed the presence of nodules in every case.

It seemed evident that the soil was not lacking in respect of *B. radicicola*, and also that the addition of agricultural lime to the soil stimulated activity.

Lupins found growing adventitiously in the orchard likewise showed vigorous nodule formation, and, moreover, colonies of *B. radicicola* were proved to exist in the farm soil by shaking up samples of the soil with sterile water, and planting out, when typical cultures of the organism were obtained.

A preliminary inspection of the grounds belonging to Lieut.-Col. J. G. Rose, at Beau Soleil, Wynberg, Cape Province, showed that, while there was evidence of nodule formation on indigenous wild clover, the development of nodules on the lucerne was very imperfect, and it was accordingly decided to put down a set of plot experiments. The soil was of the usual poor type derived from the rocks of which Table Mountain consists, and it was therefore necessary to apply fertilizer fairly freely, and the entire area, 40 feet square, was consequently given 100 lb. of basic slag and 10 lb. of sulphate of potash. Two plots were further supplied with agricultural lime at the rate of one ton per acre, and on the 9th August, 1923, six rows of lucerne were put in each of the four plots.

After five months the following notes regarding these four plots were made:—

Unlimed and inoculated—nodules few and small.
Unlimed and uninoculated—nodules few and small.
Limed and uninoculated—nodules, but not numerous.
Limed and inoculated—vigorous nodule formation.

The third of these plots (limed and uninoculated) showed the biggest and healthiest plants, whereas the plants on the fourth plot, although their nodules were more profuse, were themselves of poorer growth, the evident cause being the proximity of a row of eucalypts.

Stellenbosch.—Inoculation experiments were carried out on the farm lands at Glen Ban, the farm of the Rt. Hon. Sir T. W. Smartt. Beans and peas were sown after, as well as without, inoculation, and both inoculated and uninoculated plants developed normally and bore nodules, no difference being discernible between the one and the other mode of treatment. A wider inspection of the farm crops revealed nodules on clover and lucerne plants as well.

In this case, as in the others above detailed, the experiments were laid out in plots, but comparative results were rendered impossible by reason of the fact that cut-worms had made havoc of the crops, and only a few isolated plants remained on each plot, the peas and clover crops having almost completely disappeared.

George.—On the 18th October, 1923, plot experiments were set out on the grounds of the Government Industrial School along lines very similar to the work carried on elsewhere. Red Canadian Wonder beans were sown by hand-drilling on inoculated and uninoculated

plots, limed and unlimed, agricultural lime from Cradock being put on two of the plots at the rate of 250 lb. per tenth-acre plot. The land experimented with had been ploughed, disked, and harrowed, and was under barley the previous year. The plots were attended to, during the growing period, as customary in these experiments, by the workers on the spot, and were kept thoroughly in order, being cultivated and weeded when necessary. The yields, harvested 82 days after sowing, were comparatively poor, as the crop had suffered severely from drought, but the returns, reckoned in pounds of dry beans per acre, were as follows:—

	Yield per Acre.	Yield from 1 lb.
Unlimed and inoculated	240 lb.	4·8 lb.
Limed and uninoculated	185 lb.	3·7 lb.
Limed and inoculated	280 lb.	5·6 lb.
Unlimed and uninoculated ...	210 lb.	4·2 lb.

The best results it will be seen, were those obtained from the two inoculated plots, particularly from that which was both limed and inoculated.

Worcester Division.—Four plots each 180 square yards in extent, were laid down in October, 1923, in the lands of Mr. W. R. Meiring, Meirings Hoop, De Doorns. The entire area was manured with stable manure, and two of the plots were given 100 lb. of lime each. One of the limed plots and one of the unlimed were inoculated, 4 lb. of beans being sown on each plot. The experiments in this case were not a success, possibly owing to the quality of the beans, which germinated very badly.

Inspections of the writer's lands, near Three Anchor Bay, and of those belonging to Mr. J. W. Hurlingh, nearly two miles apart at Sea Point, in each case showed well developed nodules on wild clover roots. On the farm of Mr. J. H. Neethling, at Klipheuvel, Malmesbury Division, prominent nodules were also found on wild clover, and at Umgeni, near South Coast Junction, Natal, large nodules were noticed on beans.

EXPERIMENTS AT THE SCHOOLS OF AGRICULTURE.

(1) Cultures from the Capetown laboratory were sent to Elsenburg, and there applied to the following varieties of seed which were then sown in the usual series of experimental plots, viz.: Field peas, broad red clover, Tepary beans, and winter vetch. In no case was there any advantage apparently brought about by soaking the seeds in the bacterial cultures. Both inoculated and uninoculated plots produced nodules in similar amounts, and in all cases these amounts were small. It was also noticed that many of the indigenous leguminous plants on the lighter soils showed nodules.

Nitragin (the commercial name for an inoculating preparation containing a bacterial culture made by a German company from extracts of the nodules from certain legumes) was used for inoculating experimental crops of peas and clover. In harvesting the peas, there was found a difference in yield in favour of the inoculated plots, and in the case of the peas the average yield of the inoculated plots was 18 per cent. above that of the uninoculated, the maximum difference in yield being 4,396 lb., i.e. 7,196 lb. as against 2,800 lb. In the clovers

there was also a difference in yield, but this difference was not nearly so marked as in the case of the peas. This was probably due to the fact that the clovers were sown on a very stiff clay soil. No leguminous crops had previously been grown on the sites of the uninoculated plots, with the exception of the usual veld legumes—principally *Trifolium angustifolium*, *Medicago*, and *Melilotus* sp.

(2) Wherever lucerne lands in the Orange Free State have been inspected, nodules have invariably been found on the roots of even quite young lucerne plants on virgin soil. On the other hand, soya beans have been devoid of nodules, and have harvested poorly; while on cowpeas, also on uninoculated soil, nodules were plentiful and the yield at harvest time good.

An extensive series of plots was started on the grounds of the Provincial Agricultural School at Tweespruit, Orange Free State. It was intended to experiment with red Canadian Wonder beans, soya beans, and cowpeas, but owing to adverse climatic conditions these experiments could not be carried out completely, and ultimately it became too late in the season to do anything more than plant the Canadian Wonder beans. Drought continued until the last week in January, 1924, so it was not practicable to do any sowing earlier, and then heavy rains commenced, lasting, with short intervals of fine weather, until the end of March.

The entire area selected for the plot experiments measured 100 yards by 35 yards, and was designed for 13 parallel plots, five of which were to be controls. The continuous rains swamped the plots on the south or Thaba Pätchua end of the field, so that only those on the north side could be considered. Then hail, during the latter part of February and early in March, destroyed all the first flower-growths and reduced the yield in each case by something like 40 per cent. Finally the temperature began to fall, and frost to set in, so that nothing remained but to harvest the green pods, dig up the plants, and compile the records. In all cases the Canadian Wonder beans were supplied by Messrs. C. Starke & Company, Rosebank, C.P., and the bacterial cultures used were prepared in the Capetown laboratories of the Division. Lime was not applied in any case.

The following results were obtained from the three northernmost plots:—

No. of Plot.	Average Weight of Plant.	Bacterial Culture Used.	Yield of Green Pods per 3 Rows.	Yield per Plot.	Yield per Acre.
1	$4\frac{1}{4}$ oz. ...	Uninoculated ...	$9\frac{1}{4}$ lb.	37 lb.	888 lb.
2	$6\frac{2}{3}$ " ...	Soya bean... ...	18 "	72 "	1,728 "
3	$4\frac{2}{3}$ " ...	Bean	$14\frac{1}{4}$ "	57 "	1,368 "

The size of the plots were each 33 by 6 yards, with twelve rows of plants on each.

It must be mentioned that from the beginning of these experiments the seeds inoculated with soya bean culture germinated quickest, showed the most vigorous growth, and developed into the strongest plants.

(3) Cultures procured from Germany were tried on lucerne, cowpeas, and soya beans, without any improvement whatever being noticeable. On the other hand, good nodules were developed on all legumes grown at Potchefstroom without any inoculation at all.

Over 40 cultures, prepared in the Potchefstroom laboratories, comprising cultures specially adapted for lucerne, peas, beans, cowpeas, soya beans, clover, and vetch were distributed for use amongst farmers, and it was reported that in not a single case was any benefit from inoculation observed.

Two large-scale experiments with cowpeas were laid out on the lands of the Potchefstroom School of Agriculture, and in both cases the results were adverse to inoculation, in fact it was the uninoculated half in both cases that gave the larger yield. One of the fields was virgin soil, and there, if anywhere, inoculation if it had been needed, should have showed up favourably.

It was not possible for the Potchefstroom laboratory to undertake any further work of this kind as it was desired first of all to collect all the reports on the cultures already distributed amongst farmers.

(4) It has been decided that for the present the Cedara laboratories may issue cultures free of charge to Natal farmers specially interested in soil inoculation, on condition of the recipients furnishing the Institution with reports on the results obtained, but that there should not be any wholesale free issue.

The Cedara lands, it was stated, had failed in the endeavour to grow soya beans and other legumes on uninoculated soil. On the other hand, inoculation experiments had been carried on at Cedara with nitragin procured from the University of Wisconsin, and as a result nodules had developed.

Pot culture trials had first of all been carried out to test the influence of nitragin on the formation of nodules on soya bean roots. The variety of soya bean taken for this purpose was one which in previous field trials had failed to produce nodules without inoculation. The pot culture trials were conducted in the following way:—Twenty-five tins were filled with soil and subsoil from an area that had not previously grown legumes. These tins were arranged in five rows of five each.

The rows on the outside in one direction were not inoculated; the three inside rows in the same direction were inoculated, and the two outside and middle rows in the cross direction were limed. Thus the general scheme was as follows:—

	Limed		Limed.		Limed.
Uninoculated	0	0	0	0	0
Inoculated	0	0	0	0	0
Inoculated	0	0	0	0	0
Inoculated	0	0	0	0	0
Uninoculated	0	0	0	0	0

Hence the grouping of the individual experiments was—6 uninoculated and limed; 9 inoculated and limed; 6 inoculated and unlimed; 4 uninoculated and unlimed.

Five soya bean seeds were planted in each tin, and all the tins received equal cultural treatment.

During the period of growth little difference was noticed between the inoculated and the uninoculated plants, but on harvesting, the results indicated the efficiency of the culture, the inoculated tins producing plants growing a liberal amount of well-developed nodules, whereas the uninoculated tins failed to produce any nodules.

During the succeeding season further cultures were imported from the Department of Agricultural Bacteriology, College of Agriculture, University of Wisconsin, United States of America, and experimented with when the following cultures were found efficient and produced nodules on plants:—

Dwarf bean culture; soya bean culture; white sweet clover culture.

The pot cultures of the preceding year were used for the purpose of ascertaining the influence of the previously inoculated soil on the growth of the plant and seed production. The tins of soil did not receive any fresh treatment nor was there any further culture added, but the soya bean seeds planted produced a liberal development of nodules in the inoculated but none in the uninoculated tins.

In the harvesting, the inoculated sections showed an increase of 71·83 per cent. over the uninoculated, and the limed inoculated sections an increase of 1·07 per cent. over the unlimed inoculated sections. The plants from the inoculated sections produced 3·33 per cent. more seed than those from the uninoculated sections, and out of those that were inoculated the limed sections gave 2·43 per cent. more seed than the unlimed.

(5) A small quantity of nitragin was imported from Germany for trial at Grootfontein, and beans and lucerne were inoculated therewith. Nodules were not formed in the beans, and in the case of the lucerne there was no improvement, the latter being apparently affected by the bacteria already present in the soil.

A green manure experiment on *Melilotus indica* was commenced in the Kat River Valley, Stockenstrom District. The *Melilotus*, however, did very badly indeed. The green manure experiment was located in a citrus orchard where no lucerne had ever been grown. Lucerne is one of the most important crops on this particular farm, but it is a crop difficult to establish when first sown, although subsequent sowings on the same land do very well indeed, apparently owing to increase of bacterial vigour. Evidently therefore, on the tract of land selected for the green manure experiment the bacterial flora did not sufficiently abound in active *B. radicicola* to produce any marked effect on the short-lived, shallow-rooted *Melilotus*.

The soil on which this experiment was carried on is light and sandy, and in most cases was under native cultivation for many years. The limiting factor to plant growth there is understood to be nitrogen. On unmanured and non-rotation fields kale is very stunted and purple in colour, while maize and other cereals produce miserable crops. That lucerne at first difficult to establish grows more readily in later years is due no doubt to the fact that in course of time it becomes sufficiently infected with the depleted *B. radicicola* to be able to grow normally. If, after five years, the lucerne is ploughed in, kale, barley, and maize sown during the next two years give excellent results. If the field is then resown with lucerne vigorous growth results. So the rotation there has become: lucerne—5 years; kale, barley, and maize—2 years; lucerne—5 years. Every seven years

the lands are resown with lucerne, and on the examination of the plants from such a resown field, every plant dug up is found to have developed nodules in plenty.

Generally, it is believed the area served by Grootfontein is sufficiently rich in *B. radicicola* of the lucerne variety for the rapid infection of all crops, and it is therefore considered that for lucerne, sweet clovers, and similar crops inoculation would be a superfluous operation. There are instances, nevertheless, where beans and cowpeas fail to produce nodules.

A very important question arises here: can an interchangeability in function be developed between the different types of *B. radicicola*? The experience of the Grootfontein institution just recorded must be studied in conjunction with that mentioned in connexion with (2) above, and although normally the bacteria symbiotic with cowpeas and soya beans may not function in regard to lucerne, and vice versa, it still remains to be seen what developments may be wrought by specialized cultivation of various types.

INDICATIONS.

The experiments above outlined indicate that while there are undoubtedly localities where inoculation would prove beneficial to a leguminous crop, there are also many others where the organism is already present in the soil; hence where in such cases the crop has failed, the soil defects are chemical or physical rather than biological. This is seen for example in those instances where liming of the soil resulted in an improvement to the crop which inoculation could not achieve.

It is clear, however, that more investigation and experiment are needed. An important phase of this investigation should comprise procuring nodules from leguminous plants indigenous to the Union of South Africa, isolating and classifying the symbiotic bacteria in these, and testing them on cultivated crops.

Above all things, no mistake could be worse than to imagine that soil inoculation is going to remedy all other soil evils, such as bad tilth, poverty in plant food generally, water-logging. Inoculation cannot make up for lack of fertilizers or sourness of soil; in fact inoculation of sour soils is practically useless, as the bacteria in most cases fail to flourish in acid soil. The value of soil organisms is great indeed, but like all else in agriculture, the micro-biology of the soil simply takes its proper place amongst the numerous factors which contribute to soil productivity. Any one of these factors may be a limiting factor, and the scientific farmer will bestow all the knowledge he has on providing against *whatever* contingency may arise.

INCUBATION IN SOUTH AFRICA.

By R. BOURLAY,* Acting Chief Poultry Officer, School of Agriculture, Potchefstroom.

Part I.

It is proposed to deal with the subject of this article under the two heads of natural incubation and artificial incubation.

NATURAL INCUBATION.

Those poultry breeders who are not blessed with farm buildings such as stables, barns, etc., could, and do, hatch large numbers of chicks by the aid of "mother hen," and it is felt that she could be used far more extensively than is done at present.

So far as natural incubation is concerned, in the western districts of the Cape Province very little trouble is experienced, because hatching takes place during the rainy season. For this reason there is no necessity for damping the soil on which the nest is made. Most farmers set their hens in sheds or barns; many use the old-fashioned (built-in) nest in the fowl-house. Strong broods have been seen which have been hatched in a nest made in a cement barrel filled with straw to within nine inches of the top. These eggs hatch very easily under what would appear to be very adverse conditions because the atmosphere is charged with moisture, thus reducing evaporation to a minimum.

All that is required is a nest box, size 2 feet by 2 feet by 2 feet square; this should have a slatted front and no bottom. Select a sheltered corner in a garden or orchard, make a mound 4 feet by 4 feet by 4 inches high where the nest is to be placed, scooping out the centre to a depth of 2 inches. The advantage of the mound is that the nest is above the surrounding ground, and thus safe from flood water. Set the box firmly on the mound, with some short chaff or litter in the depression for the nest. In front of the nest box a little run 3 feet long by 2 feet high may be placed, which can be made of saplings and covered with wire-netting. From this a drinking vessel could be suspended. The advantage of such a run is that the hen is confined to her own nest and run; she may come off to feed

* Having regard to the varying conditions, climatic and otherwise, under which incubation is done in the Union, arrangements were made for the Poultry Officers stationed at the different Agricultural Schools to be associated in the compilation of this article on the subject. Mr. R. Bourlay, Acting Chief Poultry Officer, School of Agriculture, Potchefstroom, also undertook the work of collating the contributions, the other officers contributing being:—

C. C. Rhodes, School of Agriculture, Elsenburg, Mulder's Vlei.

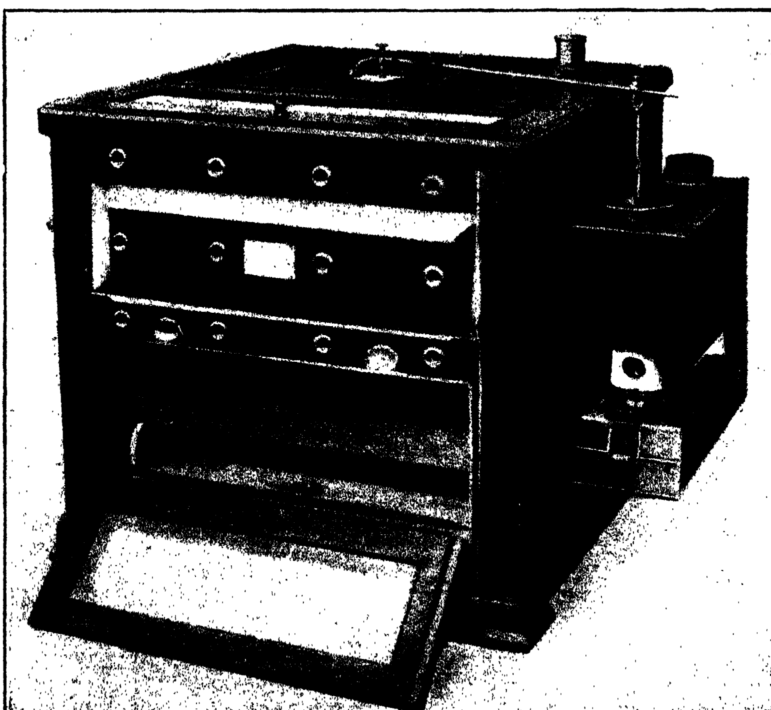
J. J. Jordaan, School of Agriculture, Glen.

T. B. Cross, School of Agriculture, Cedara.

A. Owen John, School of Agriculture, Grootfontein, Middelburg, Cape.

and drink and dust herself whenever she pleases, and thus needs very little attention. Several nests made in this way may be placed along a sheltered hedge and a large number of hens thus used as hatchers.

In dry areas hens may be used successfully for hatching purposes provided that sufficient care is taken in preparing the site of the nest. In the greater part of the Union the atmosphere is very dry, with practically no moisture; this being so, moisture has to be applied artificially. The easiest method of doing this is to prepare the nest as described above, but the soil on which the mound is made should be first dug over and well soaked with water, and the mound itself treated in a similar manner. Place the nest box on the mound,



Phipps' "Perfection" Incubator.

scoop out a nest in the centre, and pour water into the hollow. When this has been absorbed and given time to dry somewhat on the surface, line the hollow with the chaff or litter, and it will then be ready for use.

A method frequently adopted for supplying periodical moisture to the nest is as follows:—When making the nest foundation, bury a small drain-pipe two inches beneath the soil surface, the lower end of the pipe ending near the centre of the nest and the higher end just above the soil and outer edge of the nest. About 1½ pint of water may be poured into this pipe from time to time as may be deemed necessary, with the object of maintaining the necessary supply of moisture. In dry, hot areas the nest coops should be well ventilated,

as many broody hens leave their nests owing to the heat inside the box being too great.

Insects.—When hens are used for incubation, care must be taken to keep their bodies and also the nests free from insect pests such as lice, sand fleas, and ants. These will frequently worry the hen to such an extent as to cause her to leave her nest. Take every precaution to obviate this by dusting the hen well with a good insect powder before setting her and treating the nest itself in a like manner. A mixture of one part naphthaline and twenty parts flowers of sulphur is recommended for this purpose.

Selecting the Sitting Hen.—A quiet, docile hen that is not averse to being handled will always make the most satisfactory sitter. Wild, flighty hens are a common source of broken eggs, and seldom give satisfactory results. Further, it is always advisable to be sure that the hen will be content to sit in her new quarters before entrusting her with valuable eggs. The best way of ensuring this is to allow her to sit on three or four china eggs for the first day or two after removing her to her new quarters.

Always remove hens at night from the nest which they select to the nest which it is intended that they should occupy, as a sitting hen will always take more kindly to her new quarters at night-time than if removed during the day. When she has settled down and proved that she is content with her nest by sitting quietly for a couple of days or so, the dummy eggs may be removed and the real eggs substituted; this change also should be effected at night.

Selecting Eggs for Hatching.—It is well to bear in mind that a hen will hatch eggs successfully where artificial incubation would prove futile, inasmuch as eggs which are twenty to twenty-five days old may be entrusted to a reliable broody hen with every hope of good results, whereas if such eggs were placed in an incubator the result would be problematical. However, it is always wise to set eggs in as fresh a state as possible to ensure a really satisfactory hatch. Eggs for hatching should be of uniform size, all small and misshapen eggs being discarded; neither is it wise to set abnormally large eggs—those weighing from 2 to 2½ ounces each will be found to give the best results.

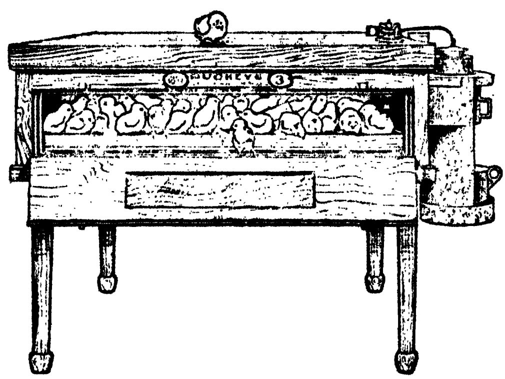
Number of Eggs.—The number of eggs to set under one hen will vary according to the season of the year and the size of the hen. During the cold weather, of course, a smaller number of eggs should be given to a hen than during the warm summer months. As to the size of the hen, one would naturally not give as large a number of eggs to a small hen as to a large bird.

Setting Several Hens on one Day.—When practicable, it is wise to set several hens on the same day, the advantage being that, when the eggs are tested on the sixth or seventh day, the unfertiles may be removed, allowing the remaining eggs, in many instances, to be comfortably covered by less hens. The surplus hens can then be given a fresh lot of eggs, thus saving time and labour. In the same manner, when the chicks are hatched, it is frequently possible to give one hen all the chicks hatched out by the hens. The remaining hens, if good sitters, can then often be persuaded to take on and hatch out another batch of eggs each, or otherwise be allowed to get

over the broody fever, when they would come into lay much sooner than if allowed to rear their own broods separately.

Pedigree Hatching.—When eggs are being hatched from tested or individual hens for pedigree purposes, the sitting hen is of great value, as eggs from each special hen can be given to different sitters, and when they hatch out each chick can be toemarked with absolute certainty, which is not always such an easy matter when the hatching is done by artificial methods.

Airing the Eggs.—The broody hen should leave the nest at least once every day. Many fail to do this, and very close sitters often remain on the nest for three or four days before leaving the eggs for food and water. Under such conditions, the hen should be gently lifted off the nest once daily and given food and water. To do so, place the hand underneath the hen, carefully lift her right off the eggs, and withdraw her from the nest. When this has been done a few times she will usually come off of her own accord for her regular feed and dust bath.



"Buckeye" Incubator.

Feeding.—During the period of incubation the food should consist of grain, cracked mealies being very useful for the purpose. The hen should be allowed to eat as much as she requires, and any surplus should be removed, for, if left lying in the run, it will only act as an inducement for rats and mice, the presence of which is very liable to disturb the hen. Under no conditions should the food be placed near the nest to allow the hen to feed whilst sitting.

Foul Nest.—When the hen is taking her daily feed it is wise to examine the nest to make sure that everything is in order. A broken egg or excreta from the hen is liable to spoil the hatch. If the nest is found to be fouled from either of such causes, remove the eggs, clean out the nest, and give fresh chaff, and wash the eggs with tepid water before replacing them. In the case of a broken egg it may also be necessary to wash the breast and feathers of the hen with warm water as they frequently become soiled with the contents of the broken eggs.

Hatching.—If all has gone well, the chicks will commence chipping on the nineteenth or twentieth day, though in the case of very stale eggs or of very heavy breeds this may be delayed until the

twenty-first day. During this critical period the hen should not be disturbed in any way. She should be given as much food as she can possibly consume on the nineteenth day, for, when eggs are chipping, nothing will induce a good sitter to leave her eggs, and the best plan to adopt is to leave her in peace. It is unwise to keep on examining the eggs to see how the hatch is progressing, as this only disturbs the hen, and will be likely to make her crush some of the eggs or newly hatched chicks.

An examination may be made on the evening of the twenty-first day, when all the empty shells should be removed, but in doing this the hen should be disturbed as little as possible. By the twenty-second day, if all has gone well, the hatch will be finished, and the hen and her brood should be removed to a previously prepared coop.

ARTIFICIAL INCUBATION.

Perhaps the subject of artificial incubation has been the cause of more controversy amongst poultry-keepers throughout South Africa than any other phase of poultry-keeping. This is believed to be largely due to the following factors:—(1) The great variation in atmospheric conditions, including the amount of humidity contained in the air in different parts of the Union (two incubator rooms only half a mile apart may vary very considerably, and what succeeds in one locality may not give satisfactory results in another: if variation is possible in such a small area, it is clear that variation throughout the Union of South Africa must be very great indeed); and (2) a difference in (*a*) period of airing the eggs, (*b*) temperature of machines, and (*c*) the best types of incubators.

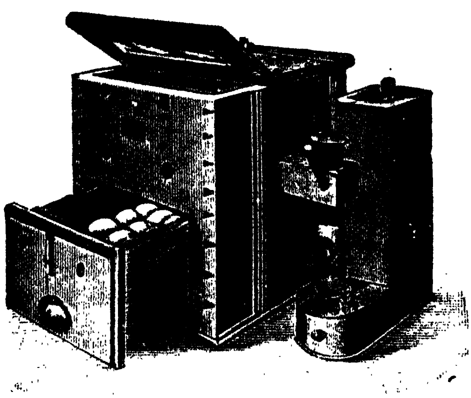
The value of artificial incubation is undoubted, for it makes the poultry-keeper quite independent of sitting hens, which have a habit of not being available when required. When necessary it is possible with the aid of an incubator to hatch successfully at all seasons of the year.

There are many different makes of incubators on the market, varying in shape, methods of heating, size, etc., but these may, however, for all practical purposes, be divided into two classes, namely, the "hot-air" or "dry" machines and the "hot-water tank" or "moisture" type. Little or no moisture is provided in the former type of machine, whilst in the latter class moisture is invariably provided in some shape or form.

Hot-Air Incubator.—This machine is simple in construction and is usually easy to work. The heat from the lamp enters the interior near the top, and is then diffused through muslin or burlap and exhausts through the bottom of the machine. It is this principle of heat entering at the top and exhausting at the bottom that is the chief feature of the hot-air type of incubator. Hot air rises quickly, but can only be forced downwards slowly, and it is claimed that with this slow movement of the air in this type of machine no undue evaporation takes place. On the coastal belt and in the mistal area excellent results are obtained with this class of incubator, whereas it is not so popular in the higher altitudes, where there is seldom sufficient moisture in the atmosphere to admit of satisfactory results. However, some of these are being used on the high veld, but in such cases extra moisture is supplied by means of trays fitted to go

under the egg tray. These are filled with water, and are kept full during the whole hatch, but must be removed during the hatching period owing to the risk of the newly-hatched chicks falling from the egg tray into the water below.

Tank Incubator.—In this type of incubator the heat is usually generated by means of an oil lamp, though where electricity or gas are available these may be employed, and effect a considerable saving in labour besides being more cleanly. The machine is fitted with a tank placed above the egg chamber through which passes a pipe which is connected with the heater at the side of the machine. In the best makes this tank is usually made of copper in order to prevent any risk of perforation through rust. The tank is filled with water, which is kept hot by the pipe mentioned above. No hot air passes into this machine, but fresh air enters at the bottom, passes through the egg drawer, and exhausts upwards. The air passes through this type of machine more rapidly than through the hot air type because the exhaust is upwards; hence, in order to prevent



Tamlin "Nonpareil" Incubator.

"Cycle" Hatcher.

undue evaporation, all incubators of this type are fitted with moisture trays beneath the egg drawers and so arranged that all air entering the machine becomes charged with moisture. The heat in this type is radiated from the hot water tank on to the eggs in the drawer.

It is claimed that the heat in the tank machines is far more regular than in the hot-air incubators owing to the bulk of hot water in the tank; the tank machine has undoubtedly the advantage of being able to retain the heat in the egg chamber for a much longer time than can the hot-air machine should the lamp accidentally go out.

The regulation of the temperature of the egg chamber is governed by a thermostat or capsule, according to the make, and readings can be taken at will from the thermometer, which is either inserted, or in some cases fixed, in the egg drawer.

It is frequently asked which is the best incubator on the market. The reply is that most makes are good, providing that the conditions for operating are right, for some machines suit one district whereas

another will give the best results in another part of the country. For instance, in the coastal area and what is known as the mist-belt, both in the Cape Province and in Natal, the hot-air type of incubator has given excellent results, as during the greater portion of the incubation season the atmosphere is well charged with moisture, which is just what is required for this class of machine.

For the inland districts, however, including the Karroo, Orange Free State, northern parts of Natal and the Transvaal, also the dry areas in the western districts of the Cape Province, the tank incubator, which is fitted with its own moisture tray, has generally been found to give the best results. This is not only because the districts are high and the atmosphere lacking therefore in moisture, but that in many of the areas mentioned the best incubation period is during the dry season when there is very little rainfall. Under such conditions it is of the greatest importance that moisture should be supplied during the period of incubation.

The Incubator Room.—The room selected for the incubators will have a very great influence on the results according to its suitability. Especially does this apply to such areas as the Karroo, Orange Free State, Transvaal, northern parts of Natal, and also many parts of the Cape, where there is a great variation in the temperature between day and night.

Along the coastal area, where the variation in daily temperature is not very great, any well-constructed room, with either an earthen or concrete floor and good ventilation, will be suitable, but in the other areas mentioned it is necessary to be rather more particular, and if a suitable room is not available it will be money well spent if an incubator room is built.

The main essentials to be kept in view are—

(1) there should be plenty of ventilation without draughts coming directly on to the machine;

(2) as little variation in temperature as is possible. This should not exceed 12 degrees during the twenty-four hours, neither should the temperature fall below 50 degrees, though it would be better if it were maintained at 60 degrees or over;

(3) the room should be absolutely free from vibration of any sort, such as may be caused by slamming doors, blasting, and the passing of heavy traffic or of trains;

(4) the floor should be firm and solid, being made of such material as will admit of moisture being thrown down and retained if necessary, and also being readily cleaned;

(5) plenty of light is necessary; the windows should be placed fairly high, and if these are on either the east, west, or north side they should be fitted with blinds which can be drawn down to prevent the sun shining directly on the incubators;

(6) the roof should be made of material which is non-conductive of heat or cold; a good thick thatch will serve the purpose excellently.

In the coastal area where very great changes of temperature are not experienced between day and night, a building which is entirely

above ground will often be available for an incubator room, and, provided that it fulfils the conditions enumerated above, there is no reason why it should not be utilized; but further inland, and in the Karroo, Orange Free State, and Transvaal, a semi-underground incubator room is far better and will give more satisfactory results. A room of this description, the floor of which is six feet below the ground-level, answers the purpose excellently. The walls should be continued to a height of four feet above the surface, which will give ample space for the insertion of windows and ventilators. The sides of the room below the ground should be bricked up to prevent the soil from caving in, and when excavating a ledge may be left round three sides of the room on which the machines may be placed. This ledge should be of sufficient width to take the required size of machines with a foot to spare, and should be bricked or concreted on both the face and top. This ensures an absolutely solid foundation on which the machines may be placed. For a 100-egg sized tank incubator a ledge of 3 feet 6 inches to 4 feet will be of ample width; the height should be such as to enable the operator to look down on to the eggs when the drawer is opened, 2 feet to 2 feet 6 inches being suitable for this purpose.

For top ventilation the ceiling should be fitted with one or more sliding ventilators with cords attached, which may be opened or closed at will, this being necessary to allow the egress of fumes from the lamps and exhausted air. A very good method of admitting fresh air to a room of this description is to have 3-inch pipes, the upper ends of which should protrude through the top of the wall into the outer air. These pipes are carried down on the inside of the room to within a few inches of the floor, and thus all fresh air enters at the bottom of the room, which keeps the atmosphere pure and ensures a good supply of oxygen. If two or three pipes are so placed on each side of the room they will provide sufficient air to keep the atmosphere within pure and sweet.

A long table should be placed down the centre of the room on which the egg drawers may be rested when the eggs are aired and turned.

The incubator room must not be used as a store-house, and on no account should paraffin be kept there. For this purpose a small oil room should be erected in a convenient position, and the lamps should be taken into this room for the purpose of cleaning and refilling.

The roof, as already stated, should be of a material which is not a conductor of heat and cold. If suitable thatch is not available tiles or slate will answer the purpose.

The size of the room will depend entirely upon the number of machines it is proposed to house. If the incubators are placed along each side of the room, a width of 15 feet will not be too great, but if only one side is to be utilized an inside measurement of 6 feet would be sufficient.

The entrance to the room should be by means of a flight of steps at one end of the building, and the surface soil around these should be slightly raised if there is any risk of flood water running down them and thus flooding the floor of the room.

(*The concluding portion of this article will be published in the next issue of the* Journal.)

THE FINANCIAL SIDE OF DAIRY FARMING.

Part IV.

The Composition of Milk and Milk Products.

By E. W. SAMPSON, B.A., Dipl.Agr.Econ. (Cantab.), N.D.D.,
Division of Dairying.

BEFORE passing on to the handling or manufacture of dairy products it will be as well to study what milk and its products consist of, with the aid of Charts Nos. 4 and 5. Each of the columns shown on these charts is supposed to represent 100 lb. of the particular product, while spaces are cut off by horizontal lines to show the proportion of the various constituents of the product. For the sake of convenience each column is made to represent 100 lb., and the amounts of various constituents can therefore be quoted as either lb. or percentages.

Chart No. 4.

We commence on the left side of Chart No. 4 with normal milk. This forms the basis of all our dairy products and is therefore the most important of all. With this, as with all the other products described, rough average figures have been used. It must be clearly understood that both milk and all the other products quoted may vary more or less widely on either side of the figures given.

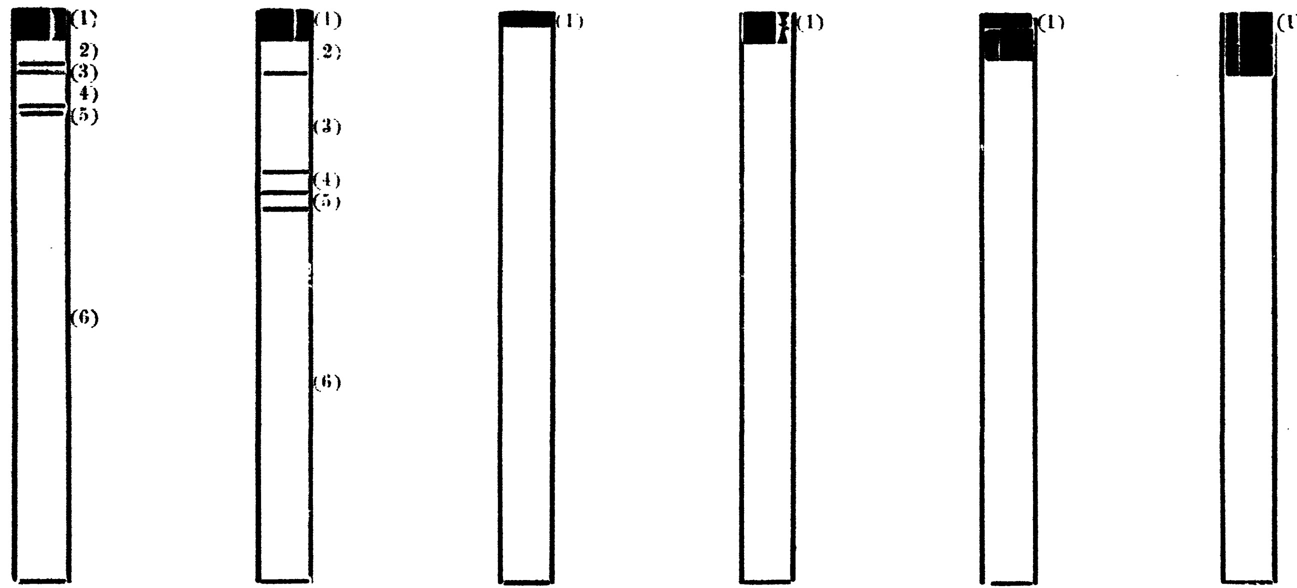
All the constituents of milk are intensely important. Looked at from a nutritional point of view, milk is a perfect balanced ration for the suckling calf. The fat and sugar are fat-forming, the casein and albumen are flesh-forming, and the ash is bone-forming. From a manufacturing point of view the fat and casein are, of course, most important, the former being the chief constituent of butter, and both of them, together with the ash, playing a large part in cheese making. Casein is also used largely in the manufacture of buttons and other artificial bone articles.

Besides these ordinary chemical constituents of milk, there are two elusive though very vital kinds of substances that we know are there by the reactions which they produce, although no one has ever seen them. They are present in too small quantity for that. The first, enzymes, are important chiefly through their action on milk in the making and ripening of cheese. The second, vitamines, are substances necessary to nutrition. Although present in various foodstuffs in such small quantities that they have never been seen, these vitamines are quite essential to growth. In Austria, after the great war, babies that were being fed a liberal amount of condensed milk, made no growth whatever until a little lemon juice and water was given them each day. Then they immediately began to grow fat and

CHART No. 4.

THE COMPOSITION OF MILK.

100 lb. Normal Milk.	*100 lb.* Colostrum.	*100 lb.* 1st Portion of a Cow's Milk.	*100 lb.* 2nd Portion.	*100 lb.* 3rd Portion.	*100 lb.* 4th Portion.



Normal Milk	Colostrum	1st Portion	2nd Portion	3rd Portion	4th Portion
(1) Fat, 3½ lb.	(1) Fat, 3 lb.	(1) Fat, 1½ lb.	(1) Fat, 3 lb.	(1) Fat, 5½ lb.	(1) Fat, 8½ lb.
(2) Casein, 3 lb.	(2) Casein, 5 lb.				
(3) Albumen, ½ lb.	(3) Albumen, 15 lb.				
(4) Sugar, 4½ lb.	(4) Sugar, 2½ lb.				
(5) Ash, ¾ lb.	(5) Ash, 1½ lb.				
(6) Water, 87¾ lb.	(6) Water, 73 lb.				
Also Enzymes, Vitamines, Bacteria, and Dirt (?).	*Also* a Purgative.				

strong. In the manufacturing process of the condensed milk, the natural vitamines of the fresh milk had been destroyed and so, although the milk was sufficiently nourishing in all other respects, the children could not make growth until the vitamines were fed to them in another form, which in this case was the lemon juice.

Every one knows nowadays what bacteria or germs are. There are, of course, good germs as well as bad germs. Bacteria can live under all sorts of conditions, but for their active development and rapid breeding certain particular circumstances are, of course, better than others. Fresh milk is an almost ideal medium for nearly all kinds of germs. Most of them prefer warmish temperatures, and fresh milk is warm. They like their food well diluted with water, and over 87 per cent. of milk is water. Some of them like flesh-forming food and some fat-forming, but milk meets the requirements of either. Whatever germs can find their way into milk are therefore almost sure to multiply and prosper. Fortunately, nature has supplied us with a particular health-giving germ which makes milk turn sour in the ordinary way, and this sourness of the milk is a check to most of the bad germs. It is like a natural disinfectant, though it can only check the other germs for a while and not kill them. This particular germ feeds on the milk sugar and turns it to lactic acid.

Germs are always associated with dirt of any kind, and it would astonish any one to see for the first time a speck of dirt in a drop of milk under a microscope. Germs may be seen in half-dozens and dozens up to hundreds, clustering round a grain of kraal dust or other foreign material. This faculty of milk for harbouring and fostering bacteria has a very important financial bearing upon our dairy industry. The subject will be referred to again in the proper place.

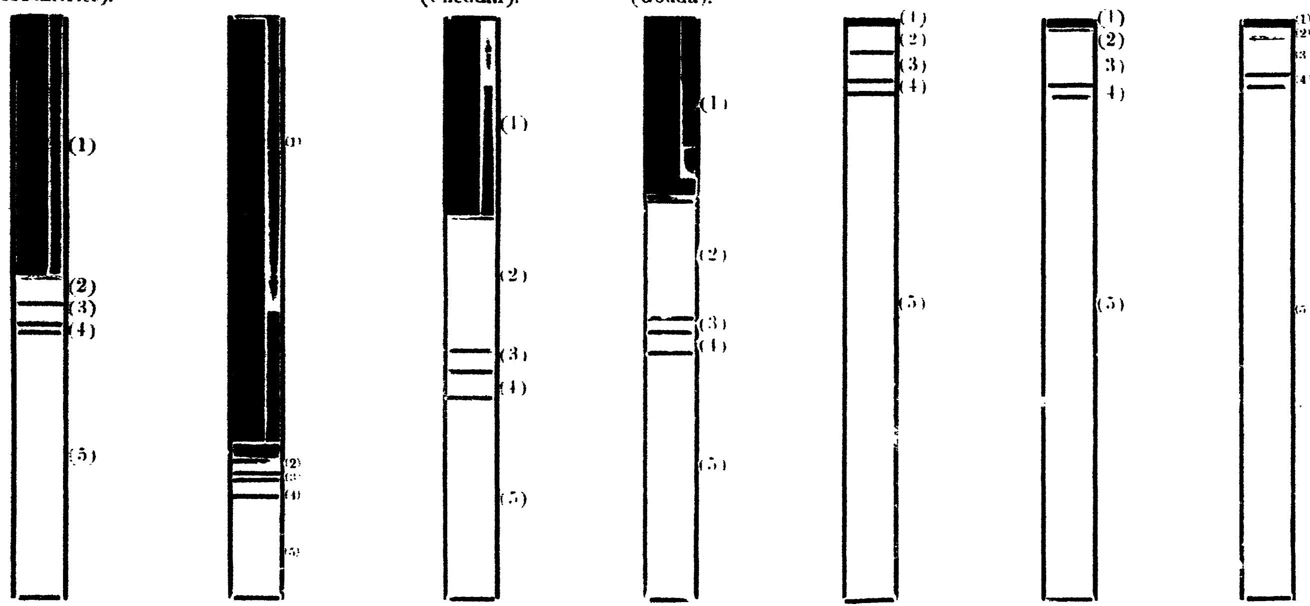
Colostrum, represented by the second column on Chart No. 4, is the milk yielded by a cow during the first few days after calving. It will be seen that the proportion in which the various constituents are present is very different to that of ordinary milk, especially in the case of albumen. This peculiar kind of milk is specially provided for the requirements of the newly born calf. It further differs from normal milk in exercising a purgative action on the bowels and thus cleaning the digestion of the young animal. A glance at the composition of colostrum will convince any one of the necessity of feeding a calf its own mother's milk for the first few days of its life at least. Ordinary milk could not possibly have the same effect.

The next four columns on Chart No. 4 show the proportions of butter-fat in the various proportions of a cow's milk. If a fourth part of the total milk of each quarter or teat of the udder were milked out and tested it would show about 1½ per cent. of butter-fat. Another fourth part of the total milk would show 3 per cent. of butter-fat, another 5½ per cent., and the fourth or last portion of the milk to be drawn would test 8½ per cent. This is important in that farmers who do not practice hand-rearing often leave the last milk for the calf to drink, and so give the calf a large proportion of the cream. When hand-rearing of calves is practised, native milkers are still prone to stop milking the cows before all the "strippings" have been drawn from the udder. It must be remembered that the last few squirts from the udder are the most valuable, besides which, cows are liable to dry up quickly if a little milk is left in the udder after milking.

CHART No. 5.

THE COMPOSITION OF MILK PRODUCTS.

100 lb. CREAM (as required by Creameries).	*100 lb.* BUTTER.	*100 lb.* CHEESE (Cheddar).	*100 lb.* CHEESE (Gouda).	*100 lb.* SEPARATED MILK.	*100 lb.* BUTTER-MILK.	*100 lb.* WHEY.



CREAM	BUTTER	CHEESE (Cheddar)	CHEESE (Gouda)	SEPARATED MILK	BUTTER-MILK	WHEY
(1) Fat, 45 lb.	(1) Fat, 82 lb.	(1) Fat, 33 lb.	(1) Fat, 30 lb.	(1) Fat, $\frac{1}{10}$ lb.	(1) Fat, $\frac{2}{10}$ lb.	(1) Fat, $\frac{1}{15}$ lb.
(2) Casein, $3\frac{1}{2}$ lb.	(2) Casein, $\frac{3}{4}$ lb.	(2) Casein, 25 lb.	(2) Casein, 22 lb.	(2) Casein, $3\frac{1}{2}$ lb.	(2) Casein, $3\frac{1}{2}$ lb.	(2) Casein, 1 lb.
(3) Sugar, $2\frac{1}{2}$ lb.	(3) Sugar, $\frac{1}{10}$ lb.	(3) Acid, 3 lb.	(3) Acid, 2 lb.	(3) Sugar, $4\frac{1}{2}$ lb.	(3) Sugar, $4\frac{1}{2}$ lb	(3) Sugar, 6 lb.
(4) Ash, $\frac{1}{2}$ lb.	(4) Ash & Salt, 2 lb.	(4) Ash & Salt, 4 lb.	(4) Ash & Salt, 3 lb.	(4) Ash, $\frac{3}{4}$ lb.	(4) Ash, $\frac{3}{4}$ lb.	(4) Ash, $\frac{1}{2}$ lb.
(5) Water, $48\frac{1}{2}$ lb.	(5) Water, 15 lb.	(5) Water, 35 lb.	(5) Water, 43 lb.	(5) Water, 91 lb.	(5) Water, 91 lb.	(5) Water, 93 lb.

Chart No. 5.

The first milk product represented in this chart is cream, which varies more in composition than any of the others. The cream represented here is the kind required by creameries for butter-making. When sold to cafés, etc., as fresh cream for eating purposes it need not contain more than 20 to 30 per cent. of butter-fat, but for creamery purposes about 45 per cent. of butter-fat is best. The germs which work in cream to spoil its clean flavour and sometimes even make it "boil over" by gas formation, live on the milky part of the cream, so that thin cream naturally goes "off" before thick cream. On the other hand, a very thick cream is not so good for butter making. Notwithstanding the latter fault, it probably pays farmers living a long way from railways in hot parts of the country, to err a little on the thick side during the summer months. For all ordinary purposes, however, 45 per cent. of butter-fat is the figure to aim at.

Casein, sugar, and ash are found in the non-fatty part of the cream in about the same proportions as they occur in normal milk. On account of there being so much fat in cream, their proportion in the cream as a whole is less than their proportion in milk.

The second column shows that butter contains about 82 lb. of fat with 15 per cent. of water, a little casein, sugar, and ash representing the butter-milk which is not all washed out, and some salt, which is, of course, added for flavouring and preserving the product. The Dairy Industry Act (No. 16 of 1918) lays down that creamery butter must not contain more than 16 per cent. of water, while the limit for farm butter and process butter is 18 per cent.

The residue of butter-milk remaining in butter is very important, as this provides food for the bad germs, which spoil the flavour of butter and make it turn bad. Rancidity is caused by a germ attacking the actual fat of the butter, turning it to butyric acid, which has the well-known rancid flavour and smell. In order to make a good-keeping butter, as much butter-milk as possible must be washed out of the butter when it is still in the grain stage, and clean water containing no bad germs must be used.

Cheese, shown in columns 3 and 4, may be regarded as concentrated milk with most of the albumen and sugar removed. In fact, what remains of the latter is turned to lactic acid by the same good germs that cause the ordinary souring of milk. Some added salt is also present. It will be noticed that Cheddar cheese contains less water than Gouda "sweet milk or Dutch cheese." Cheddar is therefore a firmer cheese than Gouda, keeps longer, and suffers less in transit. It takes a little more milk to make a pound of Cheddar than a pound of Gouda.

Separated milk has practically the same constituents as whole milk, with the very important exception of the butter-fat, nearly all of which is removed by separating. The amount of butter-fat in separated milk depends, of course, on the efficiency of the separator and the way in which the separating is handled.

Almost the same remarks apply to butter-milk, except that a certain amount of the sugar is usually present in the form of acid, giving the butter-milk its sour taste. The amount of butter-fat present may be very much higher than two-tenths of 1 per cent. if

the butter-milk has been carelessly strained from the butter. A similar waste of butter-fat may occur if fresh and old cream are mixed together and churned at once, in which case the butter-fat of the older cream will usually come together and form butter before that of the fresh cream. Much of the butter-fat of the fresh cream will then pass off in the butter-milk. For this reason, when fresh and old cream are to be churned together, it is advisable that they be thoroughly mixed at least 12 hours before. Faulty churning temperatures and other factors also influence the loss of butter-fat in favour of the butter-milk.

Whey has been found to have about half the feeding value of separated milk. Although it contains about the same amount of fat and a little more sugar it is very lacking in the flesh-forming constituent, casein. The term casein is used in this chart to cover both casein and albumen. As a matter of fact the casein of whey is, strictly speaking, one part true casein and five parts of albumen. The composition of whey varies a lot, according as the cheese is carefully or badly made. Insufficient stirring of the milk before renneting will allow fat to rise to the top and be lost later in the whey, while rough handling of the soft curd will bruise it and cause loss of both fat and casein in the whey.

In feeding separated milk, butter-milk, or whey to pigs, it must be remembered that the two former are mainly flesh-forming foods, while the latter is chiefly fat-forming.

RELATIVE PROFITS FROM VARIOUS WAYS OF "MARKETING" MILK.

Chart No. 6.

The relative profits obtainable from the various ways of marketing their milk is a vexed question for many farmers, and Chart No. 6 is an attempt to set out the matter in a simple and understanding way. The return from the sale of fresh milk to towns requires little calculation and has therefore been omitted here. Thirty gallons of milk have been taken as a basis for calculation, as this amount is considered to be a normal daily production for farms where dairying is practised. The fat percentage in the milk (3.5) is also an average figure.

We see in column 1 that if this amount of milk be separated, it will yield 10½ lb. of butter-fat, worth 10s. 6d. when the price of butter-fat is 1s. per lb. A gallon of skimmed milk has the gross feeding value (though a different kind of food) of 2 lb. of mealies. It is therefore worth about 1½d. The net return from the 30 gallons of milk "marketed" in this way (the cream sold to a creamery and the separated milk fed to pigs or calves) is 13s. 10½d.

If the milk is sold to a cheese factory (column 2) at 6d. per gallon, the net return from the 30 gallons of milk will be 15s. There may or may not be extra transport expenses for the delivery of milk. This should be taken into consideration.

Suppose the farmer makes his own butter (column 3) from the 30 gallons of milk, and obtains 1s. per lb. for the butter, which is by no means always obtainable. Although the milk yielded only 10½ lb. of pure butter-fat as paid for by the creamery, it would produce about 12 lb. of butter, for butter contains water and salt as well as butter-fat. Including the value of the butter-milk there is here a gross return of 15s. 8¾d.; but at least 1½d. per lb. must be subtracted

CHART No. 6.

FOUR WAYS OF "MARKETING" MILK.

(1) SELLING CREAM to a Creamery.

30 GALS. MILK (*3·5 % B.F.*).

$10\frac{1}{2}$ lb. Butter-fat @ 1s. £0 10 6

27 gals. Skimmed Milk @ $1\frac{1}{2}$d. ... £0 3 $4\frac{1}{2}$

Net Return ... £0 13 $10\frac{1}{2}$

(2) SELLING MILK to a Cheese Factory.

30 GALS. MILK.

30 gals. Milk @ 6d. ... £0 15 0

Net Return ... £0 15 0

(3) MAKING BUTTER on the Farm.

30 GALS. MILK.

12 lb. Butter @ 1s. ... £0 12 0

$29\frac{1}{2}$ gals. Skimmed Milk and Buttermilk @ $1\frac{1}{2}$d. ... £0 3 $8\frac{1}{4}$

Gross Return ... £0 15 $8\frac{1}{4}$

Expenses: Native Labour, Packing, Marketing, etc., say $1\frac{1}{2}$d. per lb.... £0 1 6

Net Return ... £0 14 $2\frac{1}{4}$

Net Return by selling Cream to Creamery—System (1) ... ... £0 13 $10\frac{1}{2}$

Extra Return for farmer's time and trouble in making Butter ... £0 0 $3\frac{3}{4}$

(4) MAKING CHEESE on the Farm.

30 GALS. MILK.

30 lb. Cheese @ 9d. ... £1 2 6

27 gals. Whey @ $\frac{3}{4}$d.... £0 1 $8\frac{1}{4}$

Gross Return ... £1 4 $2\frac{1}{4}$

Expenses: Native Labour, Packing, Marketing, etc., say 2d. per lb. £0 5 0

Net Return ... £0 19 $2\frac{1}{4}$

Net Return by selling Milk to Cheese Factory—System (2) £0 15 0

Extra Return for farmer's time and trouble in making Cheese ... £0 4 $2\frac{1}{4}$

TABLE showing at what prices Farm Butter and Cheese-making will pay.

Type of Produce.	Price Paid by Creamery.	Price for Farm-made Produce.	Extra Profit from 30 Gals. Milk.	Quality of Farm Produce made.
Butter ...	1s. per lb. B.F. *1s. per lb. B.F.* 1s. per lb. B.F.	9d. per lb. *1s. per lb.* 1s. 3d. per lb.	Loss, 2s. $8\frac{1}{4}$d. *Profit, $3\frac{3}{4}$d.* Profit, 3s. $3\frac{3}{4}$d.	Poor. *Medium.* Good.
Cheese ...	6d. per gal. *6d. per gal.* 6d. per gal.	6d. per lb. *9d. per lb.* 1s. per lb.	Loss, 3s. $3\frac{3}{4}$d. *Profit, 4s. $2\frac{1}{4}$d.* Profit, 11s. $8\frac{1}{4}$d.	Poor. *Medium.* Good.

for expenses. This leaves a net return of 14s. 2¼d. and brings the farmer 3¾d. more value for his milk than he would have obtained by selling his cream. The small extra profit cannot be said to justify all the trouble and risk entailed in making farm butter.

The fourth way of marketing milk offers the widest margin of profit, but cheese-making is a skilled craft; at least half the day must be given to it, and the work must proceed every day of the week, Sundays included. It is therefore an undertaking only for the few. About a pound of cheese is made from a gallon of milk and, if sold at 9d. per lb., there will be a return from 30 gallons of milk of £1. 4s. 2¼d. When 2d. per lb. is subtracted for expenses, exclusive of the cheese-maker's wages, the net return is seen to be 19s. 2¼d., leaving an extra profit of 4s. 2¼d. over method 2 of dispensing of the milk.

The accompanying table (Chart No. 6) shows at what prices it may pay a farmer to manufacture his own dairy products. If he has to sell his butter at 3d. per lb. less than the creamery price of butter-fat, there will be a loss of 2s. 8¼d. through making it. If it can be sold at the same price as butter-fat, an extra return of 3¾d. can be made on 30 gallons of milk. When the farm-butter is sold at 3d. more than the price of butter-fat, there is an extra return of 3s. 3¾d. on the day's milk. With this margin of 3d. per lb., farm butter-making probably pays, but it only exists when a good article can be put on the market and as long as the demand for farm butter is not over-supplied.

When 30 gallons of milk can be sold at 6d. per gallon to a factory, and farm cheese is made instead and sold at 6d. per lb., there is a loss of 3s. 3¾d.; if the cheese can be sold at 9d. per lb., there is an extra return of 4s. 2¼d.; and if there is a difference of 6d. between the price of milk per gallon and cheese per lb., there is an extra return of 11s. 8¼d. With this margin in hand it probably pays to make cheese on the farm if a partner or member of the household other than the farmer himself can make the cheese. It will not pay to hire a skilled cheese-maker to handle so small a quantity.

Outbreaks of Animal Diseases: May, 1925.

Disease.	Transvaal.	Natal.	Cape.	Orange Free State.	Transkei.	Total for May, 1925.	Total for Calendar Year, 1924.
East Coast Fever	—	10	—	—	—	10	125
Mange	6	—	4	—	2	12	455
Anthrax	7	6	6	2	35	56	1,494
Dourine	—	—	1	—	—	1	14
Glanders	—	—	4	—	—	4	56
Tuberculosis	—	—	—	—	—	—	18
Epizootic Lymphangitis	—	—	—	—	—	—	2

CODLING-MOTH IN APRICOTS.

Preliminary Report on the Biology of the Codling-moth and its Control in Apricots, Wellington, during the 1924-1925 Fruit Season.

By F. W. PETTEY, Ph.D., Entomologist, Elsenburg School of Agriculture.

Part I.

INTRODUCTION.

CODLING-MOTH, the most serious insect pest of apples, pears, quinces, and walnuts in those parts of the world, including South Africa, where they are of commercial importance, has only been casually mentioned in literature as a pest of some stone fruits, and then only when the latter are growing near or among apples and pears. A recent bulletin on "Codling-moth Control in the Pacific North-west," including California, where probably more pears and apricots are grown than in the whole of the rest of the world, states: "In addition to apples and pears, codling-moth has been recorded as infesting cherries, plums, prunes, and apricots. These infestations are of little consequence, usually occurring where such varieties are interplanted with badly-infested apples." Although in the Santa Clara Valley, pears and apricots are grown extensively in the same districts, codling-moth is not even mentioned as a pest of apricots in Californian entomological bulletins.

It has been known for many years that this pest will seriously infest certain varieties of peaches and plums in South Africa if they are grown among pears and apples, especially during seasons of small pome fruit crops, but the codling infestation has always been considered to be connected with the pears and apples that served as a breeding-place for carrying over the second and third broods.

In Wellington for the past three or four years codling has not only been maintaining its existence in apricot orchards a half-mile or more distant from its usual host plants, but it has been causing serious loss in many orchards to apricots and Kelsey and Wickson plums.

HISTORY OF CODLING INFESTATION IN WELLINGTON.

Codling-moth doubtless originated in Wellington apricot orchards from pear and apple trees. Mr. John Marais reports that fifteen years ago he had some large apple trees growing near large

Cape apricots which were more than forty years old. For two years in succession he noticed that the Capes were badly infested with codling. Thinking that the very wormy condition of the apples was the cause of the infestation in the Capes, he destroyed the apple trees. For thirteen years afterwards the Cape apricot orchard was still kept, and during that period there was practically no codling, the pest having rapidly died out after the apples were removed. Mr. Marais attributes the very small amount of codling in his orchard of Royal apricots at present to the soil in his orchard being different from ordinary apricot orchard soil of the district. The matter requires investigation.

Mr. Charles Cillie reports that he noticed codling in his apricots in 1914. He then had a few old pear and apple trees, which he removed in 1919 because the pest was increasing in his apricots. Nevertheless, the pest has maintained itself in the apricot orchard, and the infestation continues to be severe.

Mr. Roland Taylor states that codling began to infest his apricots about four years ago. Mr. Taylor has one orchard of trees which are about thirty years old. Growing near by, on an adjacent farm, are a few badly infested neglected quince and pear trees.

As the area planted to apricots has increased and that of the pome fruits has decreased, this insect was driven to feed and breed in the stone fruits. It has not only been able to maintain its existence in them, but it seems to have acquired a liking for them, and a one-generation strain appears to have developed.

The fact that Moorpark and Tilton varieties are mostly grown in California under irrigation, while in Wellington almost all the apricot crop consists of varieties different from these, grown without irrigation, may have some significance concerning no infestation of apricots in California.

LOSSES OF APRICOTS DUE TO CODLING-MOTH.

The infestation in the many orchards of Wellington where codling has become established varies from 5 per cent. to 90 per cent., the degree of infestation depending evidently on the variety and the amount of attention given to its control by the fruit-grower (Table 1). The early-ripening varieties, i.e. Early Retief, Alpha, and Newcastle appear to suffer most, due possibly to being more advanced in maturity and therefore more odoriferous at the time the majority of moths are flying and laying their eggs. Royals, which follow a little later, are often badly infested. Tiltons, which ripen latest, are the least infested. The average infestation in apricot orchards where no measures of control are adopted was about 30 per cent. the last two seasons. Kelsey and Wickson plums often suffer as much loss.

NATURE OF INJURY.

The larva or worm injures the fruit by burrowing into it as soon as the worm hatches from the egg. Wormy fruits often ripen and fall from the trees prematurely. No infested fruits, nor fruits slightly damaged by the worm, can be exported. Many quickly rot and are a total loss. Those infested fruits which are used for drying are of poor quality and entail extra labour in preparing them.

APPEARANCE AND HABITS OF CODLING IN APRICOTS.

A knowledge of the habits of the insect and ability to recognize its different stages are necessary for the fruit-grower if he is successfully to control it.

The Moth.—The adult stage, which is seldom seen by the fruit-grower because it is active only after sunset, is a small inconspicuous moth about three-quarters of an inch long (Fig. 1).

The two front or upper wings are light grey, crossed with several dark grey stripes, and have a large bronze oval spot at the tip. The hind or under wings are covered when the moth is at rest, and are pale light brown. The moths live about two weeks and feed very little. The females lay most of their eggs after sunset or at night, the average being about 40 per female, the number depending on the night temperature. It has been known for some time that the moths lay most of their eggs when the temperature after sunset or at night is above 60 degrees F. Consequently, in Wellington, where the night

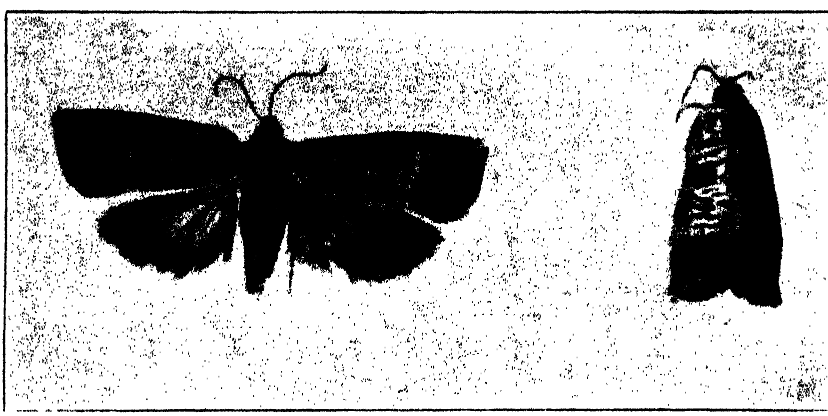


FIG. 1.—Adult Codling-Moth: considerably enlarged.

temperature in early summer is generally very warm, moths may be expected to lay the maximum number of eggs. Eggs are laid singly and scattered, some on the leaves and some on the fruit. On pears, the majority of the eggs of the first generation are mostly laid on the leaves, but the percentage laid on apricot fruit is very likely greater, because at the time the spring moths are depositing their eggs in apricot orchards the fruit is comparatively larger and more mature than pears.

The moths may fly a mile or more, but it is not likely that many in an orchard travel far, because their main object in flying is to find fruit on which to lay eggs. The wind probably does not carry many a great distance, because they actively fly only towards night, when there is generally no wind. However, there are conditions which influence many moths to fly from one section of an orchard to another. Varieties of apricots developing early may have an odour which will attract moths from other parts of the orchard. When an early variety is harvested, moths developing from larvae which escaped from the fruits of that variety before it was picked will fly to other

sections of the orchard where fruit may be found on which to deposit eggs.

There is no doubt, however, that some moths fly from one orchard to another, and this is the principal method by which the pest spreads from one apricot orchard to another.

The Egg.—The egg is circular, convex, semi-transparent, the size of an ordinary pin-head, and white when it is first laid (Fig. 2). A few days later a red ring appears in it, and a day or two before the egg hatches, a tiny black spot, the head of the worm, is easily seen through the shell. The eggs hatch in from five to sixteen days, depending on the temperature, the average in Wellington being probably ten days early in the season and five days in midsummer.

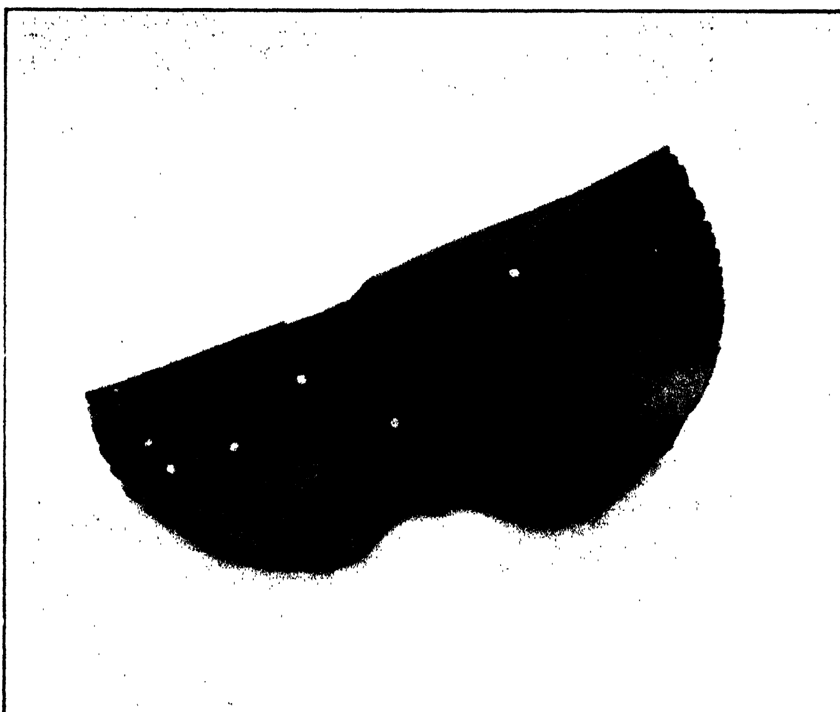


FIG. 2.—Codling Eggs on apricot leaf: natural size.

The Larva or Worm.—The larva of the codling-moth is generally found in the infested fruit or in the cocoon under loose bark. When full grown it is a little less than an inch long, and is white or pink, with a dark brown head (Fig. 3). The young, tiny larva, white with a black head, and so small that it is generally not noticed by the fruit-grower, as soon as it hatches from the egg, immediately seeks and very soon finds an apricot fruit, in which it burrows. It discovers a place on the fruit where it can most easily dig itself in, such as a weather crack in the skin, often occurring in the Newcastle variety, the groove around the top of the stem, or where one fruit touches another. The majority enter the groove around the stem or

FIG. 3.—Stages of Codling-Moth: somewhat enlarged. *A*, larva; *B*, pupa in cocoon; *C*, adult.

the sides of apricots, unless there are weather cracks in the skin of the fruit resulting from late rains (Fig. 4). Although the majority of worms enter the blossom end of apples and pears, this is not the case with apricots, because the latter have no calyx cup to furnish a foothold for them to dig themselves in.

The larvae that hatch early in the season feed in the fruit for about forty days. The later-hatching larvae probably feed for a little more than a month. When the larva is full grown it burrows to the surface of the fruit and crawls out of the fruit, generally

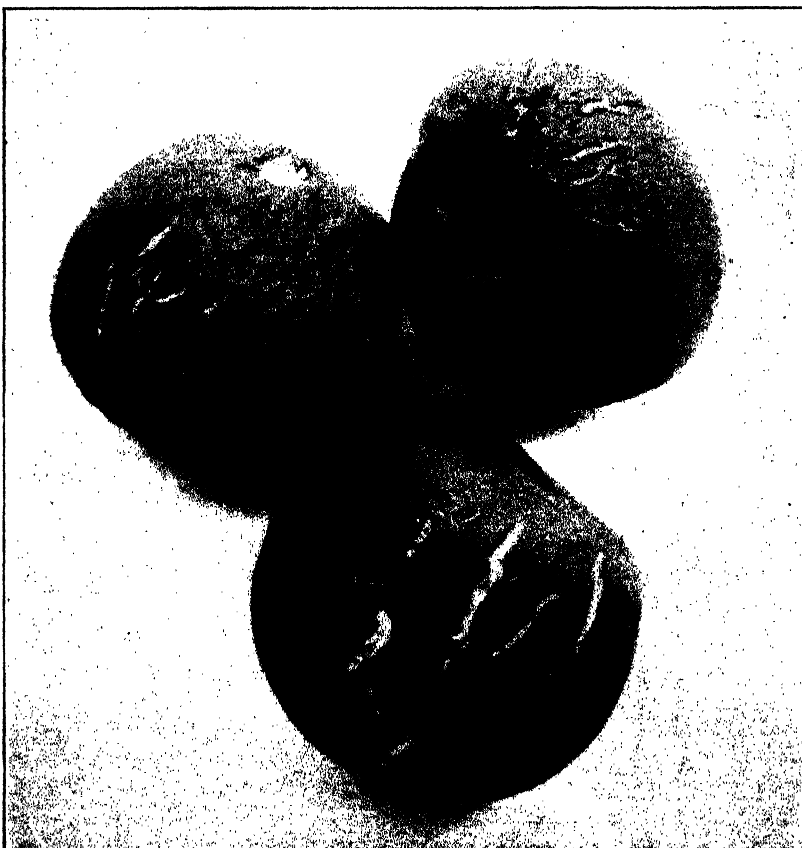


FIG. 4.—Weather Cracks in Newcastle Apricots. Note codling infestation in crack.

at night, and down the branches to find a sheltered place, often under loose bark or in the grooves of the bark, to spin its cocoon (Fig. 3). The young larva often leaves the entrance hole which it has made in the apricot before it has burrowed more than one-tenth of an inch from the surface, and in the so-called "sting" a resinous drop of gum-like material often forms and hardens. It is possible that one larva may pass to several fruits and cause such an injury before it finally burrows deeply into a fruit and develops there. Thus several fruits may be so injured by one worm that they

are not fit for export. Forty-three of seventy-eight wormy apricots obtained from an unsprayed Royal tree showed these undeveloped infestations, or " stings," which the young larvae had left. These " stings " have no bad effect on fruit for the jam factory or for drying, but are serious on fruit grown for export.

No evidence has been found that larvae burrow into the tips of green apricot twigs, or eat along the veins of apricot leaves. Although they sometimes feed in these parts of pear and apple trees in the absence of fruit, they cannot fully develop in them.

The Cocoon and Pupa.—The cocoon is formed of white silk threads, which are often interwoven with tiny pieces of bark or wood. Cocoons are found under loose bark of trunk and branches, in cracks of stumps, in the refuse which often collects in the angles of the large branches with the trunk, in the ground at the base of the tree trunk, and in cracks of the floor and sides of fruit-sheds and fruit-boxes, or any similar sheltered places.

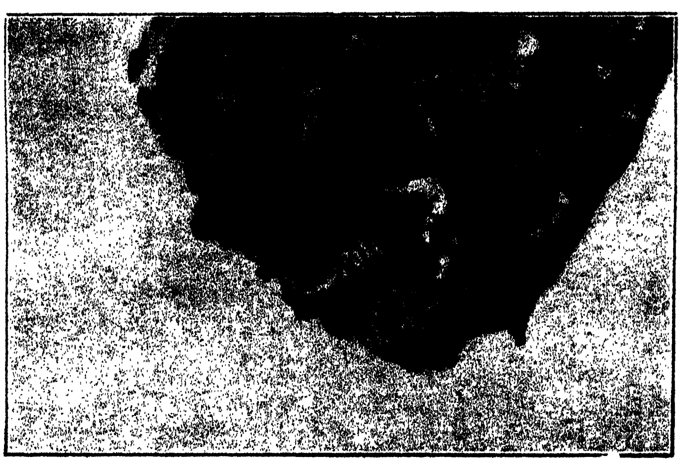


FIG. 5.—Adult Moth just emerged from pupa.

The larva remains in its cocoon for a number of days and then transforms to a pupa, which is oval in shape, first yellowish, and later dark brown (Fig. 3). This is the resting or transformation stage from the larva to the adult moth. The insect remains in the cocoon for a minimum of fourteen days, and finally the pupa wriggles partly out of the cocoon, the pupa case splits open in front, and the adult moth emerges (Fig. 5).

SEASONAL HISTORY.

The fruit-grower, in order to understand the limitations of the measures of control, and the necessity for applying them at the right time and thoroughly to get successful results, must be acquainted with the seasonal history of the pest in the district where his orchard is located.

Wintering Larvae or Worms.—The codling-moth remains over winter in the larval stage in the cocoon, in sheltered places, mostly under loose bark of orchard trees, and in or near the fruit storeroom in cracks of wood, etc. These wintering larvae include those of the last summer's broods which left the fruit before it was disposed of.

Spring Moths.—In early spring the wintering larvae transform to pupae in cocoons, and after a week or more the pupae develop into adult moths. The moths which develop from the wintering larvae are called the spring moths. The spring moths began to emerge in Wellington this last season on the 6th of September, at the time when the Royal apricots were a little more advanced than in full blossom, and when Early Retiefs, Capes, Alphas, and Newcastles had dropped their petals.

The earliest eggs laid began to hatch on the 11th of October, about a month after the Royals had dropped all their petals. Consequently, a codling spray, to be effective and to be put on the trees at the right time, should have been applied this season during the first week of October, or should have been finished no later than the 11th. Further investigations will indicate if this interval between the time of setting fruit and hatching of the earliest eggs is constant every season.

During 1924 the spring moths emerged from their wintering cocoons over a long period, approximately from the 6th of September to the 26th of November. Since the maximum emergence of spring moths occurred during the last week of October, according to records kindly made by Mr. Keith Taylor, the maximum hatching of eggs of the first generation occurred about the 7th to the 10th of November.

If it were possible and practical to apply a second spray on apricots for codling control without seriously burning the fruit and foliage, the correct time during 1924 would have been, according to the records, during the first week of November or just before the maximum hatching of the first-generation eggs. The spring of 1924 was continually cool, which doubtless prolonged the length of time during which spring moths emerged, and had some influence on the number of eggs deposited and the time of maximum hatching.

It is now commonly known that codling-moths lay very few eggs when the early night temperature is lower than 62 degrees F. The writer has repeatedly observed that the warmer and more humid the night temperature is, the more eggs are laid by a female moth. Therefore, if the night temperature is generally high during the period of spring-moth emergence, i.e. during September, October, and the first week of November, a more severe infestation may be expected.

First Generation.—The first generation begins when the eggs are laid by the spring moths, and includes larvae, pupae, and moths developing from them.

The earliest eggs, which were exposed to considerably cooler weather than those laid later, hatched in sixteen days after they were deposited. Eggs laid in October hatched in eight days. In midsummer they would no doubt hatch in five days.

Larvae hatching from the early-deposited eggs fed in Newcastle apricots on the trees from 37 to 49 days before leaving the fruit to

spin their cocoons. The average length of time the larvae of the first generation or brood feed in the fruit would probably be about four weeks, since they would more rapidly develop as the weather became warmer. The earliest larvae remained transforming in cocoons 16 to 34 days before the adult moths emerged.

The earliest adult moth of the first generation appeared the 5th of December.

The whole life-cycle of the earliest-hatching individuals from the time the egg was laid until the resulting moth appeared ready to lay eggs of the second generation, was from 66 to 94 days. Doubtless later-hatching individuals would complete their life-cycle in a minimum of two months.

The Second Generation.—Many larvae of the first generation winter in their cocoons and do not develop into moths until the next spring. Consequently, there is a comparatively small second generation. The eggs of the second generation hatch in five days. The earliest young larvae appeared in 1924 about the 12th of December, consequently they could not complete their development before the end of the first week of January. Therefore practically no larvae of the second generation can complete their development in Royal apricots or other varieties, the harvesting of which is completed before or by the end of December. Some individuals of the second generation may, however, develop fully in Tiltons and other stone fruits such as Kelseys and Wicksons, harvested later than the first week of January.

Overlapping of Generations.—The latest spring moths to emerge from wintering cocoons appeared the 26th of November, and the earliest adult moth of the first generation appeared the 5th of December. Moths bred from weekly collections of larvae from bands on trees in the orchard continued to emerge until the 16th of February. Consequently, there was only a very short period when moths were not emerging in the orchard during the whole of the fruit season from the 6th of September until the middle of January. So, except for a short interval during the first ten days of December, larvae were hatching and attacking fruit from the 11th of October until the fourth week of February in the orchards where late-ripening fruits existed.

Wintering of Larvae and its Significance.—Eleven Royal apricot trees in Mr. Charles Cillie's orchard were banded in early spring with strips of hessian, and larvae were allowed to collect in them without disturbance during the whole season until the 20th of March. When they were examined on that date, 238 codling larvae were found dead in cocoons under the bands, 104 living, wintering larvae were found in cocoons, and there were only five pupa cases from which adults had emerged. These records show that 68 per cent. of the codling larvae succumbed to heat in the bands on trees in the orchard, 94 per cent. of those surviving the summer temperature passed the winter in cocoons, and only 6 per cent. developed into moths during the season. Thirty-one larvae were collected from bands on Alpha trees the 25th of November, the cocoons of which were not disturbed. These larvae were among the first to leave the fruit during the season. When they were examined in late autumn, 21 living larvae were wintering, 5 had developed

into moths, and 5 larvae had died. This shows that a large percentage of even the earliest larvae of the first generation winter over.

The fact that the great majority of the first generation of codling larvae which have developed in apricots hibernate, explains why colding-moth is able to maintain itself in apricot orchards from year to year. If the majority were to develop into moths the same season in apricot orchards where there were no late-maturing stone fruits, the pest would be negligible since the larvae hatching from eggs would have no food on which to subsist or in which to develop.

It is interesting to note that over 90 per cent. of first generation codling larvae develop into moths in pear orchards of the Stellenbosch District.

Larvae found last year in considerable numbers of dried and decayed apricots, remaining over winter on the trees and on the ground in the orchards, and which are similar in appearance to codling-worms unless they are greatly magnified, do not develop into codling-moth. They belong to a species of dried-fruit moth, *Myelois-ceratoniae*, which infests dates and figs in various parts of the world. It has been discovered that this larva infests acorns in Wellington and Orchard Siding.

It is unfortunate that the codling-worms do not winter over in dried or decayed apricots on the trees or on the ground in the orchard. If they did, it would afford the fruit grower an easy means of finding and destroying those which remain over winter in the orchard to become moths in the spring and infest the new crop.

A One-generation Strain in Apricots.—This discloses the important fact that in Wellington apricot orchards there is practically a one-generation strain of codling-moth, due probably to the very high prevailing day and night summer temperature in this district and possibly to the medium in which the larvae feed.

It has been noticed that larvae collected in cocoons from apricot trees in the Wellington orchards in midsummer are not nearly so active as those collected in cocoons from pear trees in the Elsenburg pear orchard, where the temperature is considerably lower than in Wellington. Probably the temperature in Wellington approximates the maximum in which codling-moth can exist.

Why Codling Infestation in Apticots is less than in Pears.—The average infestation in a non-sprayed pear orchard would be 90 per cent. or even higher. The average infestation in an apricot orchard where codling has been established for a number of years in Wellington is probably about 30 per cent. It is less severe in Wellington apricots because a large percentage of the larvae of the first generation succumb to heat and because the majority of the surviving larvae of the first generation winter over, resulting in a comparatively very small second generation of larvae. In the commercial pear orchards there are three generations of codling larvae, very few succumb to heat, and the second generation is a very large one in unsprayed orchards, because very few worms of the first generation hibernate.

(*The concluding portion of this article will be published in the next issue of the* Journal.)

SALDANHA AND GRAHAMSTOWN PHOSPHATES.

Some Experiments and Their Results.

SOME interesting experiments were made during the war by Mr. A. Stead, Senior Chemist and Officer in Charge of the Union Soil Survey, in an endeavour to ascertain whether Saldanha phosphate could take the place of basic slag, superphosphate, and bonemeal. The results of these experiments are now published as a Departmental bulletin,* the main features of which are outlined below.

The position in 1917, it will be recalled, was such that the production of more wheat was an urgent necessity, and we were faced with the problem of increasing the output without the aid of basic slag and superphosphate, which were obtainable in very limited quantity only, and at famine prices. Considerable quantities of kraal manure and bonemeal were, however, available. At that time Mr. Stead wrote a pamphlet (now out of stock), entitled "The Shortage of Artifical Manures; the Economic Use of our own Resources," the summary of which stated:—

(1) The use of kraal manure alone is both wasteful and undesirable;

(2) kraal manure should be used in conjunction with a phosphate;

(3) Bonemeal that will pass a 100-mesh sieve is a phosphate suitable for use with kraal manure;

(4) the use of coarser bone is uneconomical in so far as immediate needs are concerned.

These points are as important to-day as they were during the war period, but we are now in the happy position of being able to fortify kraal manure with cheap superphosphate as well as with bonemeal; and it is moreover much easier to obtain finely ground bonemeal.

The bulletin refers to the large deposits of phosphate in the neighbourhood of Saldanha Bay, and the indefinite nature of our knowledge at that time of its value as a substitute for basic slag, superphosphate, or bonemeal. There was no time for field trials or such-like experiments: definite information was required before the next seeding time. This led Mr. Stead to attempt to estimate

* Science Bulletin No. 36, "Some Experiments on the Solubility of Saldanha and Grahamstown Phosphates in the Soil," by A. Stead, B.Sc., F.I.C., Senior Chemist and Officer in charge of the Union Soil Survey; obtainable from this office; price 3d. prepaid.

the rate at which Saldanha Bay phosphate became available in the soil.

Two types of soil were selected for the experiments, namely, (1) fine-sandy, red Karroo: a soil that is alkaline and markedly humus-deficient; (2) Grahamstown sandy loam: a soil that is acid and rich in humus.

These two contrasts were chosen because, among other reasons, it was being freely stated that Saldanha Bay phosphate (which is a siliceous iron-aluminium phosphate) would give best results with acid humus-rich soils. But the experiments detailed in the bulletin would seem to negative this assumption, the best results having been obtained with the Karroo soil.

A food-substance is not usable by plants unless it is dissolved in the soil-water which, entering the plant by way of its roots, carries the food-substance with it. Now, while laboratory tests showed the phosphoric oxide of Saldanha Bay phosphate to be insoluble in water, this did not preclude the possibility of it becoming soluble through contact with warm, moist soil. The phosphoric oxide of bonemeal, for instance, is quite insoluble in water, but it becomes soluble as the result of the action of soil agencies on it. Saldanha Bay phosphate could then be considered a phosphatic manure if, like bonemeal, its phosphoric oxide became soluble in water within a reasonable time after it was placed in the soil.

The experimental method used to determine this point consisted in (1) adding known quantities of Saldanha Bay phosphate to the soil; (2) maintaining this in a moist condition over a total period of about 160 days; (3) occasionally adding sufficient rain-water to produce good percolation; and finally (4) collecting and analysing the drainage waters. In this way the amounts of phosphoric oxide contributed to the drainage waters by both the soil phosphate and the added phosphate were found. These amounts, for reasons that cannot be explained here, are to be regarded as the least that would become available for use by a crop growing on the soil.

Coming to the results, the phosphate of the Karroo soil yielded nearly four times as much water-soluble phosphoric oxide as the phosphate of the Grahamstown soil. Whereas an application of 1,000 lb. Saldanha Bay phosphate per acre-foot increased the water-soluble phosphoric oxide by 40 per cent. in the case of the Karroo soil, it made no practical difference to the amount of water-soluble phosphate obtained from the Grahamstown soil. Further, when applied to the Karroo soil, the rate of solubility of the phosphoric oxide of the Saldanha Bay phosphate was at least thrice that of the soil phosphate. While, therefore, Saldanha Bay phosphate did not act as a phosphatic fertilizer when applied to the Grahamstown acid, humus-rich soil, it behaved as a slow-acting phosphatic fertilizer when used with the Karroo alkaline, humus-deficient type.

In the case of the Karroo soil, the effect of adding kraal manure with the Saldanha Bay phosphate was also ascertained; but little, if any, increased solubility of either the soil-phosphate or the Saldanha Bay phosphate resulted. Likewise, sodium bicarbonate gave almost negative results.

Similar experiments were made, in the case of the Grahamstown soil, using a very low-grade phosphate, derived from the Dwyka shales

of West Hill, Grahamstown, in place of Saldanha Bay phosphate. This phosphate gave much better results than the Saldanha Bay phosphate, especially when used in conjunction with sodium carbonate. The Grahamstown soil-phosphate itself also became, relatively speaking, rapidly soluble when the soil was treated with sodium carbonate. Herein, the author observes, the beneficial action on crops of applications of vegetable ash (which contains sodium and potassium carbonate) to soils of the Grahamstown type, finds explanation. In passing, it may be pointed out that the ash left after grass-burning is doubtless often beneficial, in that it would lead to an increased availabilty of the soil-phosphate. In the regions where grass-burning is practised or necessary, the soil-phosphate is usually so unavailable that the vegetation is very phosphate-deficient and causes pica in cattle. If this be so, then wherever soils are sandy and acid and grass growth so rank as to necessitate burning, the farmer who allows his natives to burn cattle manure would do well to collect the ash, store it in a dry place, and, when a sufficient quantity has been accumulated to make it worth while, spread it on the land or the veld.

Citrus Growing in the Sundays River Valley.

The Sundays River Citrus Co-operative Company, Ltd., has issued the first number (April, 1925) of a publication entitled "The Citrus Grower," which is intended to serve as the organ of the company and a medium for the interchange of citrus news in general. It contains interesting matter to those engaged in citrus culture, and in a foreword, soliciting the help of all citrus growers, states: "The interchange of ideas, experiences, and discoveries will greatly help towards success, as we are pioneers in a new locality, where conditions or appropriate methods may differ from those prevailing elsewhere." Communications should be addressed to the Editor, care of the Secretary, Sundays River Co-operative Co., Ltd., "Moira," Addo, Cape Province.

THE COMPOSITION AND QUALITY OF BRANDIES.

MR. FEVRIER, the Department's Assistant Viticulturist, read last year before the Cape Chemical Society an interesting paper on "Comparative Results of Analyses of Spirits and Brandies." This has now been published by the Department as a Science Bulletin,* and will be found valuable to all concerned in the industry. The chemical examination of brandies and spirits to reveal their quality and composition requires consideration of several factors, such as method of distillation and method of maturing.

Distillation may be effected by the pot-still method, in which case the resulting brandy is a "cognac." If the patent still or rectification column be used, a pure industrial spirit is obtained. There is a marked difference in the composition of these two classes of brandies or spirits. The brandy distilled by the pot-still or cognac method contains certain constituents, such as volatile acids and higher alcohols. These in the process of maturing, which is chiefly one of oxidation, go to form the esters, and give to the brandy its mellow flavour and bouquet. The maturing of a brandy takes time, and is best effected in oak casks. For this purpose a constant but small supply of air is required, and it is freely supplied to the brandy through the pores of the oak fustage in which it is contained, and where, according to Blarez, the oxidation takes place. French brandies mature thus for at least five years, and the best are as much as ten, twenty, or even forty years of age.

A spirit distilled by the patent still does not contain the substances essential to the development of the bouquet and flavour of a cognac brandy, however long it may "mature"; the law permits, however, the addition of certain colouring and flavouring substances, thus converting the spirit into a potable brandy in a very short space of time.

The nature of the receptacle containing the maturing "cognac" brandy is of the utmost importance. It must be to a certain extent porous and contain a small amount of tannin. These conditions are ideally realized by oak wood, hence the reason why only oak casks are used for maturing the best "cognac" brandies. In air-tight receptacles, such as earthenware jars, glass, or event cement tanks, maturing does not take place.

A detailed chemical analysis will reveal the nature of a brandy or spirit, and by considering certain constituents by themselves or in relation to others in the form of ratios, the chemist can give his opinion as to whether the one or the other of the two methods of distillation mentioned above has been used and whether maturing of the resulting spirit has taken place to any extent or not.

A chemical examination, however, will be of little use to

* "Comparative Results of Analyses of Spirits and Brandies," by F. Fevrier, B.A., Assistant Viticulturist. Science Bulletin No. 37. Obtainable on application to the Department of Agriculture, Pretoria.

determine the quality of the brandy; this the analyst, who must be a connoisseur, will decide after a critical organoleptic examination.

In his paper Mr. Fevrier gives the results of complete analyses of three industrial spirits and three brandies, and discusses these results in their relation to the origin and age of the spirits.

The Soil under Irrigation.

It is a common belief that, if only water be available, unlimited crops can be produced on any and all kinds of soil. There is no greater fallacy in agriculture, and this idea has caused many farmers grievous disappointment.

The soil is the most important factor to be considered in any irrigation scheme, however small. If the soil is not suitable the scheme will fail partially or totally, because irrigation is an artificial device of man to supplement Nature's rainfall, and Nature has not in every case provided the soil that can be irrigated successfully. A soil for irrigation should be of good texture, should be well supplied with humus, should have the depth necessary for the crops which are to be grown on it, and should have good underdrainage.

As regards texture a desirable soil is one that will absorb the water fairly quickly, allow the excess to drain away at a reasonable rate and at the same time retain sufficient water for the crop. The soils that answer this description are those known as loams, the types best suited to irrigation. A sandy soil will take up the water quickly and allow it to drain through equally rapidly, but it will not retain enough. By the incorporation, however, of organic matter such as kraal manure or by green manuring, the water-holding capacity can be considerably increased. Clays on the other hand are very difficult soils to manage under irrigation. They take up the water very slowly; the rate of drainage is very slow and there is always a great danger of waterlogged conditions. Here again the addition of organic matter is very beneficial in that it gives the clay soil a more "crumbly" structure, and hence better percolation and drainage. The supply of humus in all irrigated soils must always be kept up in order that the very desirable "crumbly" structure and mellowness of tilth be preserved. It is often found that loam soils, after some years under irrigation will "run together" and form a hard crust. Organic matter will alleviate this.

Good drainage is a very necessary attribute in an irrigated soil. The water in the soil moves either downwards or upwards according to conditions. If the drainage is good the water will move downwards and out of the soil taking any undesirable "brak" salts with it; otherwise, the water is drawn upwards and evaporates from the surface of the soil leaving any salts it may contain on the surface and in the surface layer where they can do most damage. This is a very dangerous state of affairs and needs special consideration, because almost all the waters used in South Africa for irrigation contain small quantities of "brak" salts; hence by irrigation the farmer can, if the drainage be bad, actually cause "brak" conditions where they formerly did not exist.

The farmer who intends to irrigate should first of all study the soil and ascertain whether the scheme can be made a success. (*Glen School of Agriculture.*)

PINUS INSIGNIS Doug. (*Pinus radiata* D. Don) IN SOUTH AFRICA.

With Special Reference to its Growth at Tokai Plantation, Cape Province.

By N. L. KING, District Forest Officer, Tokai, Cape Province.

Part I.

INTRODUCTION.

THE rapidity of growth of *Pinus insignis* in South Africa, coupled with the prospect of the yield of a crop of merchantable timber after a comparatively short period, has gained for this tree such a widespread popularity that to-day it is one of the best known of our introduced timber trees. The activities of the Forest Department have, during the past forty years, resulted in the establishment in various localities of the Union of large areas of plantations of *Pinus insignis*. Quite apart from this, however, the private tree-planter has for many years favoured this species. The sale of nearly three-quarters of a million cubic feet of *Pinus insignis* timber at Tokai in 1918 undoubtedly aroused further public interest, and gave an added stimulus to the raising of this species by private enterprise.

Although growth data are incomplete, sufficient information is nevertheless available to indicate that the growing of *Pinus insignis* in suitable localities and under proper management is a sound economic proposition.

The available evidence indicates clearly that while the timber of *Pinus insignis* is useful for a variety of purposes, it is very well adapted for use in the boxwood and crate industry—an industry which is annually becoming of greater importance.

Though large areas of land have been placed under *P. insignis*, there are still thousands of acres of suitable land which are lying practically idle. This is especially true of the southern coastal districts of the Cape Province. When it is remembered that in favourable localities timber of merchantable size, to meet the demand of the boxmaking and other rapidly expanding industries, can be raised in the comparatively short period of about twenty years, the economic possibilities of an even more extensive planting of this species become at once apparent.

Name.—While the name *P. insignis* is the one by which the Monterey Pine is commonly known, the more correct name, in accordance with the laws of botanical nomenclature, is *Pinus radiata* D. Don. Briefly, the confusion of naming arose as follows: Douglas, who discovered the tree in 1831-2, forwarded specimens to England under the name of *Pinus insignis*. This manuscript name was not

published until 1838. Meanwhile, specimens collected by Dr. Coulter were taken to England, and Don, unaware of Douglas' manuscript name, published in 1835 a description of the tree under the name *P. radiata*. Thus, strictly speaking, Don's name has priority of publication, and as such is entitled to precedence. The tree has, however, become so widely known in South Africa as *P. insignis*, to the almost entire exclusion of the name *P. radiata*, that the priority claims of the latter name have been disregarded.

NATURAL DISTRIBUTION.

Locality.—The natural distribution of *Pinus insignis* is very restricted. It is found only at three points on the Californian coast, south of San Francisco, and on the islands of San Guadolupe, Santa Rosa, and Santa Cruz. The largest natural forest is that of Del Monte, on the Monterey Peninsula. This forest covers an area of between 5,000 and 6,000 acres.

The Santa Lucia mountains are the natural habitat on the mainland, and it is of interest to note that the tree is found only at the northern and southern extremities of the mountain range, in spite of the fact that apparently favourable habitats exist in the intervening region. It has been suggested that* geomorphic movements are the causal factors of this peculiar and restricted distribution.

The northern and southern occurrences lie approximately between the thirty-fifth and thirty-seventh parallels of N. Latitude.

Climatic Conditions.—The climate of the Monterey Peninsula is characterized by a winter rainfall, daily fogs during the summer, and an extremely mild and equable temperature. Following are some particulars:—

The average annual rainfall of Monterey Peninsula, based on records for twenty-five years, is 18·13 inches. The maximum and minimum annual rainfall for which records are available are respectively 28·66 and 10·10 inches. This rainfall occurs in winter and early spring. The summer fogs, however, which drift in daily from the ocean play an important part in the growth and reproduction of the tree, inasmuch as they prevent any excessive drought and compensate very considerably for the rather low winter rainfall. The mean annual temperature is 56·4° F. The highest temperature on record is 80° F. and the lowest 30° F. August is the hottest month of the year, with an average maximum temperature of 61·9° F., and January the coldest, with an average minimum of 50·2° F.

The highest point on the peninsula is 800 feet above sea-level, and from here the ground slopes gently down to the ocean.

Soils.—These vary from an almost pure sand (found in the dunes along the beach) to a fine sandy loam, which lies in a belt from one-half to a mile wide along the lower slopes behind the sand dunes. On the upper slopes the soils are, for the most part, gravelly or sandy clays.

Growth.—In the Del Monte Forest the tallest tree of which a record is available was 115 feet high and 42 inches in diameter, while the tree having the greatest volume was 82 feet high and

* "Geobotany of the Santa Lucia Mountains," Forrest Shreve. Year-book of Carnegie Institution of Washington, 1918.

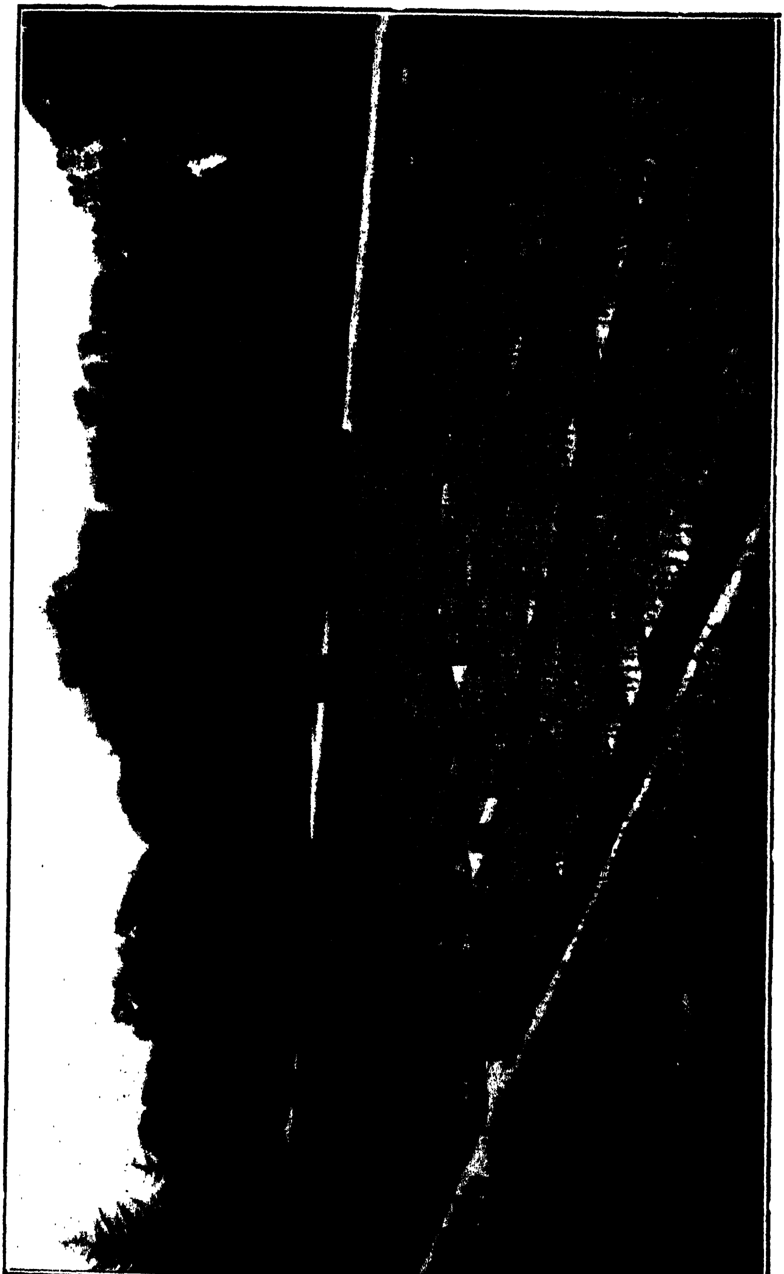


FIG. 1.—Retreat Nursery, Cape Peninsula, showing *Pinus insignis* Transplants.

[*Photo by S. A. R. and H.*

59 inches in diameter. Elsewhere the trees occur mostly in groves, and are rather stunted in character, although trees having a height of 70 feet are occasionally encountered.

Tabulated figures of the rate of growth in forest formation are given later under "Rate of Growth."

INTRODUCTION INTO OTHER COUNTRIES.

A striking commentary on the introduction of *Pinus insignis* into South Africa, New Zealand, and Australia is contained in the following statement by Wilson*:—"Altogether, so far as the evidence goes, it rather looks as if this pine will prove the North's greatest gift to the new forest in these parts of the world. It will surprise others no doubt as greatly as it did me to find a species of so little value in its native land to be of such immense importance in the Antipodes."

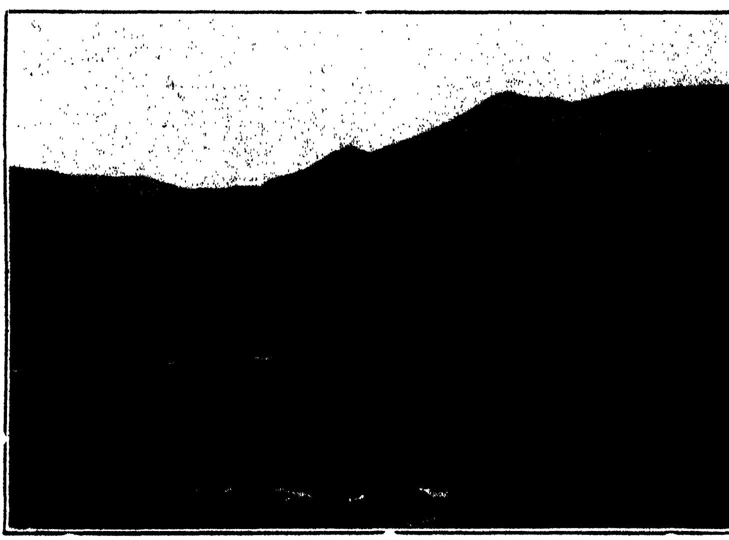


FIG. 2.—*Pinus insignis*, 1 year old, in Compt. A. 6, Tokai Plantation.

Australia.—In South Australia *Pinus insignis* has been planted fairly extensively for upwards of forty years, and it has also been planted in Victoria and New South Wales. In South Australia it is planted on soils varying from a light sandy loam of poor quality to fairly stiff arable land, the best results being obtained on moderately strong clay loam of fair depth, overlying permeable clay.

The climate is not unlike that of the south-western districts of the Cape Province. The latitude is about the same, and the rainfall, occurring chiefly during May, June, July, and August, with occasional showers during October to December, averages about 21 to 35 inches per annum. The rotation varies from twenty-five to thirty-five years.

* "Northern Trees in Southern Lands," E. H. Wilson. *Journal of the Arnold Arboretum*, Vol. IV, No. 2, April, 1923.

Stands which have been measured give a mean annual increment of from 245 to 254 cubic feet per acre, while a stand thirty-three years old cut a few years ago yielded over 100,000 superficial feet per acre, inclusive of all material down to 3 inches in diameter.

New Zealand.—The exact date of the introduction of this species into New Zealand is most uncertain*, but existing plantations indicate that extensive plantings were made from forty to fifty-five years ago, after earlier planted specimens had indicated the remarkably rapid growth of the tree.

In New Zealand any premeable soil appears to suit *Pinus insignis*, although it thrives best in the fresh, free pumice loams on the central North Island.

The planting espacements adopted vary from 6 ft. by 6 ft. to 10 ft. by 10 ft., an 8 ft. by 8 ft. espacement being most commonly found.

The available figures of growth are very incomplete. A tentative volume return per acre is given as follows:—

Age.	Volume. Cub. Ft.	Volume. Super. Ft.
18 years	4,300	30,960
30 years	8,600	61,920
35 years	11,500	82,800
40 years	15,400	110,880

Cockayne† states that the yield of timber is approximately 100,000 superficial feet per acre at thirty years, and that diameters of over 16 inches are obtained in the first twelve years. He is further of opinion that a rotation of from eighteen to twenty years is quite sufficient for the production of timber for box-wood. If the 100,000 superficial feet represents a yield of converted timber, and the same reducing factor as that given above be employed, then the equivalent volume per acre would be 13,888 cubic feet per acre. Similarly, the yield of 100,000 superficial feet quoted for South Australia would, if the same factor were employed, also be 13,888 cubic feet.

This yield of 13,888 cubic feet per acre for a thirty-year-old stand of *Pinis insignis* differs considerably from that of 8,600 cubic feet for stands of this age mentioned in the table. The yield of 8,600 cubic feet per acre, however, agrees closely with a yield at Tokai of 7,600 cubic feet under bark or (after making an allowance of 16 per cent. for bark) of 8,796 cubic feet over bark.

British Isles.—*Pinus insignis* has also been introduced into the British Isles, and is referred to by Henry ‡ as showing remarkably fast growth in the milder parts of England, Wales, Ireland, and south-west Scotland.

South Africa.—It has not been possible definitely to ascertain when *Pinus insignis* was first introduced into South Africa. The earliest reference in the annual reports of the Forest Department is

* "*Pinus radiata* in New Zealand." Circular No. 3. New Zealand State Forest Service.

† Cockayne in *New Zealand Journal of Agriculture*, January, 1914.

‡ "Forests, Woods, and Trees in Relation to Hygiene," A. Henry.

contained in the report for 1883. In that year there were 250 plants on hand at Tokai. According to Lister, formerly Chief Conservator of Forests for the Union of South Africa, the seed from which these plants were raised was obtained from a tree growing in the Botanic Gardens, Capetown. This tree, most probably the first in South Africa, must have been planted some years previously.

In 1884 about 20 lb. of seed were imported and distributed to Tokai and Kluitjes Kraal Plantations, and is was at these centres that the first extensive plantings of *Pinus insignis* were carried out.

PINUS INSIGNIS IN SOUTH AFRICA.

Description of Tree.—*Pinus insignis* has become such a well-known tree in South Africa that it is as a rule easily recognized by

FIG. 3.—The same stand 4 years later. The trees are 5 years old. Height, 25 ft.; d.b.h., 3½ in.

[*Photo by S.A.R. and H.*

its characteristic appearance. When grown under suitable conditions it is a tall, straight tree having an undivided stem and a small, conical-shaped crown. When grown in the open it is inclined to branch heavily, and in close plantation formation the branches are very persistent. The slender dark green needles are from 4 to 6 inches in length, and are found usually in fascicles of three. It is, however, not uncommon to find on the same tree fascicles containing two, three, and even four needles.

Varietal Forms.—An insular two-needled form, var. *binata*, is referred by Sargent* and other writers as being found on the San Guadolupe, Santa Rosa, and Santa Cruz Islands. So far, however, this form has not been recorded in South Africa.

Gill, formerly Conservator of Forests, South Australia, distinguishes two forms of *P. insignis*—one with large and the other with small cones. The latter form, he states, is usually a much better balanced type of tree, the side branches being small and the taper very gradual, thus giving a model trunk for milling purposes. In South Africa two forms have also been noticed—the one with small and the other with large and widely-spreading branches. As yet, this difference in habit of branching has not been definitely correlated with any botanical difference.

Frequently a peculiar manner of growth is noticed in certain trees in their early stages, and leading shoots without any nodes are found. In these instances it would appear that the whorl of buds usually formed at the end of a season's growth has, for some reason, failed to develop lateral branches.

Root.—It develops a strong root system, and when planted on deep soil is quite wind firm except in the very early stages of growth. Occasionally 2 to 3 year old trees growing in sandy soil are loosened by the wind. Sometimes also it has been found that trees growing in a shallow soil have been uprooted by the wind.

Seeds.—The seed of *Pinus insignis* is small and winged, the wing being about 1 in. long and $\frac{3}{8}$ in. broad at its widest part. 100 lb. of fresh cones yield from 1.6 to 1.9 lb. of cleaned seed and 1 lb. of cleaned seed contains from 15,000 to 17,000 seeds. As a rule not more than 50 per cent. of the seeds are fertile and a germination of 7,500 to 9,000 plants per lb. of seed is a good result. Cockayne† gives the number of seeds per lb. as 14,000 and states that a 50 per cent. germination is usually obtained in New Zealand.

Seedlings.—When the seedlings emerge from the soil they bear a whorl of 5 to 9 cotyledons, 1 to $1\frac{1}{2}$ in. in length. These are succeeded by primary needles which are borne singly on the stems and not in clusters. When the plant is a few months old the secondary needles, borne in fascicles, each fascicle containing usually 3 needles, commence to appear, but both primary as well as secondary needles occur until the plant is about 3 years old; after this, only secondary needles are produced.

Cones.—Cones may be borne at a very early age and fertile seed has been collected from 7-year-old trees. At Tokai, the female flowers appear in May and the male in July or beginning of August. Pollination takes place about the middle of the latter month. The cones, when ripe, exhibit considerable variation in size and shape, being from 2 to $5\frac{1}{2}$ in. in length, having a maximum width of $1\frac{1}{2}$ to 3 in.

Ability to Coppice.—Sim‡ recommends in certain circumstances the coppicing of *Pinus insignis.* At Tokai alone, many

* "Silva of North America," C. S. Sargent.

† "The Monterey Pine," A. H. Cockayne, *New Zealand Journal of Agriculture*, Vol. VIII, No. 1, January, 1914.

‡ "Pine Tree Culture in South Africa," Sim, in *South African Journal of Industries* January, 1921.

thousands of *Pinus insignis* trees have been felled during the past few years, and in no single instance has a coppice shoot appeared.

SYLVICULTURE.

In South Africa *Pinus insignis* has been planted in a great diversity of localities, and very often without any regard to the sylvicultural requirements of the tree.

The results obtained from planting will generally be in direct proportion to the degree in which the locality is able to fulfil these sylvicultural requirements.

Rainfall.—In order to compensate for the lack of the daily summer fogs which this tree experiences in its native habitat, the tree in South Africa seems to require at least 25 in. of rain per annum,

FIG. 4.—*Pinus insignis* in Compt. B. 25, Tokai, 8 years old. Mean d.b.h. 3·9 in.; mean height 42 ft.

unless the soil is exceptionally deep. In its native habitat and also in those parts of South Africa where the most satisfactory results are obtained, the rainfall is either wholly in winter or else throughout the year. It has been suggested that the tree demands a winter rainfall and is, generally speaking, unsuited to summer rainfall areas. In the present state of our knowledge, however, it seems inadvisable to lay this down as a definite principle, for much of the comparative failure of the species in Eastern South Africa has undoubtedly been due to the fact that the tree has been planted under dry conditions of soil and climate in which it could not be expected to succeed, and in which it fails even where the rainfall is a winter one.

In its native habitat *Pinus insignis* is essentially a coastal species and it fails in the hot dry interior of California. Similarly in the interor of South Africa there is a risk in planting it where it

has continually to withstand a hot dry atmosphere. If planted inland it should be confined to the cool-side of mountains, high up if the soil is suitable, where mists occur.

Spring Droughts.—In Natal, *Pinus insignis* frequently dies back from the top. Henkel, formerly Conservator of Forests, attributed this dying back to drought and in this connexion states:—"As is well known the pine starts growing in the winter or early in spring when there is least moisture in the soil and hot dry winds are frequent. The heavy lower branches transpire freely and reduce the amount of water available for the leading shoots. If the lower branches are pruned away to a reasonable height, more water is rendered available for the leading shoots."

Altitude.—The question of altitude appears to have a considerable bearing on the success of *Pinus insignis*. At Tokai the best results are obtained on the mountain slopes at an altitude of from 1,000 to 1,500 feet above sea-level, while on the flats below, even in good soil, there is a marked difference in the size of the trees.

Temperature.—The explanation of the question of altitude appears to be intimately associated with temperature. Taking the climate of the Cape Peninsula as being the nearest approach to that of Monterey, we find that the average annual temperature at the Royal Observatory, near Capetown, is 5.9° F. warmer, and that the difference in extremes is 76.8° F. as compared with 50° F. at Monterey. Following are the figures:—

TABLE 1.

	Monterey Peninsula (readings over 25 years).	Royal Observatory (readings over 38 years).
Mean annual maximum	61·9° F.	70·7° F.
" " minimum	50·2° F.	53·6° F.
" " temperature... ...	56·4° F	62·3° F.
Highest temperature on record ...	80·0° F.	107·3° F.
Lowest " " ...	30·0° F.	30·5° F.

It is known that, in their natural distribution, trees ascend to higher altitudes with decreasing latitude and vice versa. Capetown is roughly 2½ degrees nearer the equator than is Monterey, and, furthermore, it does not enjoy the same modifying influence of summer fogs. Consequently the mean annual temperature of Capetown, as shown by the records, is a good deal warmer than that of Monterey, and it may reasonably be concluded that in order to obtain the optimum conditions for *Pinus insignis* a higher altitude is necessary to compensate for the warmer climate.

In Natal the question of altitude to compensate for increased temperature is of importance. Sim, in his "Tree Planting in Natal," writes:—"On the coast it (*Pinus insignis*) has not been a success; in the Midlands it usually attains about 20 years of age, and 12 to 18 inches diameter before it dies, and farther up country where planted in the mist-belt or higher in the moist Drakensberg neighbourhood, where winter rains or snows occur, it has seldom failed."

Soil.—*Pinus insignis* appears to be somewhat exacting in regard to soil. It dislikes lime and badly drained situations and makes inferior growth on poor or shallow soils. Further information as to the types of soils in different localities in which the tree is growing is given later. Generally speaking, however, it may be said that the tree requires for its best development a moderately fertile soil. Situations on the lower slopes or foothills of mountains are especially suited to its cultivation.

SUITABILITY OF DIFFERENT KINDS OF LOCALITY FOR GROWING OF *Pinus insignis.*

There is no part of the Union where the climatic conditions resemble very closely those obtaining in the native habitat of *Pinus insignis*.

FIG. 5.—General view of Tokai from Vlakkenberg. The *Pinus insignis* in foreground are 13 years old, average height about 65 ft., average d.b.h. 6·5 in.

[*Photo by S. A. R. and H.*

South-western and Southern Coastal Districts of Cape Province.—The coastal belt of the south-western and southern districts of the Cape Province extending from the neighbourhood of Piquetberg to Humansdorp is undoubtedly the most suitable area in South Africa for the cultivation of *Pinus insignis*. In the climate of the south-western coastal districts is found the nearest approach to that of Monterey. The points of similarity are a winter rainfall and a more equable temperature than in other parts of the Union. Moving eastwards from the Cape Peninsula, with a practically entire winter

rainfall, the temperature remains comparatively equable, but the rainfall becomes a both summer and winter one until in the Humansdorp District only 50 per cent. to 60 per cent. falls during the winter months.

In this area the tree attains its best development on light loam derived from Table Mountain sandstone and on soils of granitic origin. Good results have also been obtained on Bokkeveld soils of sufficient depth. On the poverty-stricken sandy soil high up in the mountains and on the poor sandy soil of the Cape Flats growth is unsatisfactory. On the heavy soils of the Malmesbury series overlying pot clay, the rate of growth is slow, but nevertheless fairly good stands have been produced under these conditions. In addition to variations of soil in this large area, there are local climatic variations to be considered, and local conditions should always be studied in order to test the suitability or otherwise of any particular area.

South-eastern Coastal Districts of Cape Province.—From Humansdorp eastwards the proportion of winter rainfall gradually decreases with a corresponding increase in the proportion of summer rainfall. Experience has proved that the tree is not suited to dry low-lying areas, and should be confined to the mountains at fairly high altitudes. In some mountain localities, particularly where mists are of frequent occurrence, there are some good stands, e.g. at Hogsback near Alice, at an elevation of 3,753 feet and having a rainfall of about 50 inches.

In this portion of South Africa there is always the danger of damage by hail with the subsequent probability of infection by *Diplodea pinea*, and this constitutes a factor of unreliability.

In lower and drier portions of the Eastern Cape Province *Pinus insignis* does not succeed.

Transkei.—In the Transkei the rainfall is practically wholly in the summer and the factor of unreliability mentioned above is more pronounced. It has usually been grown, and in some cases good results have been obtained, at fairly high elevations on soils mostly of doleritic origin. The stiff clay soils derived from the Beaufort series do not seem suitable for it.

Natal.—In the coastal districts of Natal *Pinus insignis* has failed, and it is generally agreed that if planted at all it should be planted only in the mist-belt, or higher in the Drakensberg area.

Orange Free State.—Reports from the Orange Free State indicate that, generally speaking, *Pinus insignis* is a failure. Even in the most favoured part—the Eastern Orange Free State—it becomes stagheaded and dies at a comparatively early age.

Transvaal.—In general it may be stated that the tree is not suited for the Transvaal. At different places there are some fine single specimens, and at a few plantations there are stands which look promising. On the whole, however, the species is unreliable and because of this cannot be recommended for planting on any large scale.

Methods of Propagation.

Pinus insignis is very easily propagated from seed. This propagation falls naturally into two categories: (*a*) artificial—where the seed is sown by hand; (*b*) natural—where propagation is obtained from self-sown seed.

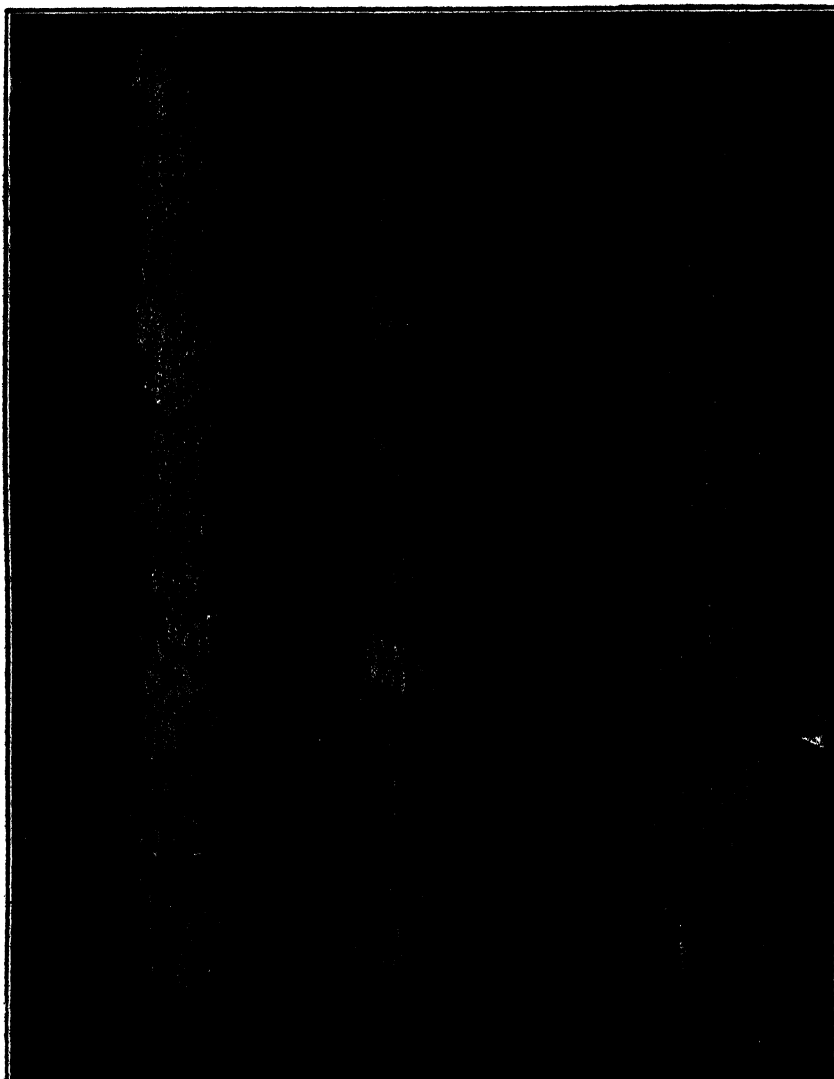


FIG. 6.—A stand of *Pinus insignis* in the Government Plantation at Tokai, Cape Peninsula. The trees were 24 years old, and over 100 ft. high when the photograph was taken.

ARTIFICIAL PROPAGATION.

This method is again sub-divided into: (*a*) nursery sowings; (*b*) direct or *in situ* sowings on the ground where the timber is to be raised.

NURSERY SOWINGS.

The method of nursery sowings is by far the most commonly employed means of raising this species in South Africa. The seed is sown in half paraffin tins and the seedlings pricked out into transplant trays, about 25 plants being put into each tray. When the transplants are about a year old they are of sufficient size for planting

FIG. 7.—*Pinus insignis* in Compt. B. 31*b*, Tokai 27 years old. Average height, 87 ft.; mean d.b.h., 12 in.

out in the prepared ground. The seedlings are pricked out preferably before the commencement of winter, and the transplants are then ready for planting out by the following planting season. The plants may also be raised in beds, but usually the result is not so satisfactory as when trays are used. It might be mentioned, however, that at French Hoek Plantation, Cape Province, where the conditions are exceptionally favourable, fairly extensive plantings have been successfully made with open-rooted transplants taken from beds. The transplants have proved very hardy, and the method is, of course, more economical than when the usual transplant trays are used.

Planting.—Observance of the following directions tends to ensure the success of planting:—

Water the plants before removal from the trays so that the soil does not easily fall away from the roots.

Use a trowel to remove the plants from the tray, and do not injure the roots unnecessarily.

If the plants have been raised in beds, puddle the roots in a mixture of clay and cow manure.

Pack the plants in boxes or trays and cover them with damp sacking to prevent the roots from drying.

Put the plants out as quickly as possible.

Plant during rainy or dull weather.

Plant to the same depth as the trees stood in the trays or beds and press the soil well down about the roots.

Watering is not necessary. One should wait until sufficient rain has fallen so that the soil is thoroughly wet before planting is commenced.

Planting Season.—In the south-western districts of the Cape Province the best season for planting is in June or July. It is risky to plant in the autumn as the autumn rains are frequently followed by a spell of dry weather. These periods of drought are very injurious to plants freshly set out.

In the midland coastal districts the season for planting is not so definite as in other parts, as rain falls more or less at all times of the year. Autumn planting is preferred, but planting may be done throughout the year provided that weather conditions are suitable.

In the eastern districts planting is carried out about January at the mountain stations if good rains have fallen by then. In the eastern coastal districts it is done during the cool autumn months. In the Transkei, Orange Free State, and Transvaal, the best season is from December to March. From these general principles which have been laid down small deviations may be necessary in order to meet small variations in local conditions, and those who intend to plant or sow are recommended to obtain advice from the local district forest officer, who is well acquainted with the particular conditions.

Yellowing.—In the poor sour soils of the Knysna and Humansdorp Divisions and in Eastern Pondoland nursery seedlings often remain stunted and turn a sickly yellow. The precise cause of this yellowing is somewhat obscure, but there seems to be no doubt that it is due to soil deficiency. In the midland coastal districts the trouble is obviated by the addition of 1 oz. of Square Brand fertilizer to each nursery tray.

At Cecilia Nursery (Cape Peninsula) a similar condition occurred. A liberal dressing of liquid manure restored a healthy colour and induced normal growth.

The same condition of "yellowing" sometimes occurs in plantations where the soil is sour and poor.

The foliage turns yellow and the plants appear to make no progress and some of them may die. Usually after a couple of years the foliage regains its normal colour and the normal growth is resumed.

"IN SITU" SOWINGS.

This method is not employed very extensively for *Pinus insignis* and should only be used where conditions are favourable. It has the advantage of being somewhat cheaper than the method of nursery sowings, and in virgin soil where natural vegetation and weeds are not aggressive it is recommended. On the other hand, where rank growth quickly follows cultivation, *in situ* sowing of *Pinus insignis* is not likely to prove a success. The seedlings either become overgrown or in order to prevent this frequent weeding is necessary and this item greatly adds to the cost of formation. Also on steep hillsides liable to wash direct sowings have proved unreliable. Where *in situ* sowing is carried out it is recommended that it be done by

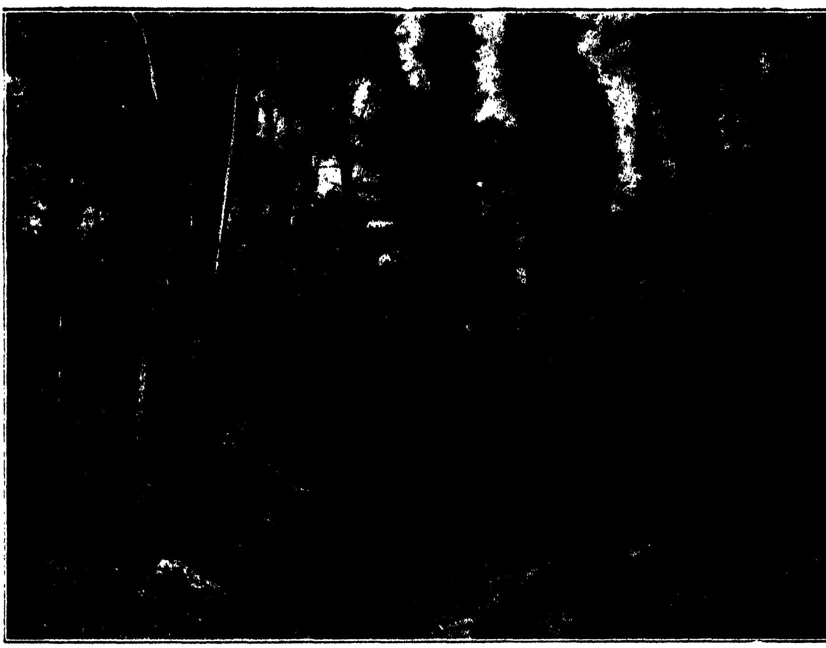


FIG. 8.—*Pinus insignis* 35 years old in Compt. B. 40, Tokai, Cape. Height 140 ft. ; average d.b.h., 20 in.

[*Photo by S. A. R. and H.*

means of "spot" sowings, i.e. the sowing of 8 to 10 seeds in spots at the desired espacement. In this way one pound of seed will be sufficient to sow one to two acres according to the espacement adopted. The spots should be in alignment so that they can be easily located should any weeding become necessary.

In the south-western districts of the Cape Province the best season for sowing is from the middle of April until the beginning of May. Rain usually falls at this time. The seed germinates before the cold weather sets in and the plants become well established before the commencement of the dry summer. Sowing may also be done during the latter part of July or the beginning of August, but the result is not so satisfactory.

In the midland and eastern districts and in the Transkei *in situ* sowings should be made in the early autumn, i.e. February to March.

In the Transvaal and Orange Free State *Pinus insignis* is not sown *in situ*.

NATURAL REGENERATION.

As yet *Pinus insignis* has not exhibited a decided tendency to spread into the veld in the same manner as does *Cluster* pine, although both species have winged seeds which are light and easily transported by wind. Here and there an isolated naturally regenerated plant is encountered, but this is more the exception than the rule.

Under forest conditions *Insignis* pine regenerates itself freely, and no difficulty should be experienced in effecting natural regeneration.

At Tokai in stands 10 and 33 years old, killed by fire, a splendid regrowth ensued from seed shed by the parent trees and this was quite sufficient to restock the area.

A copious regeneration followed the exploitation of areas at Tokai during 1918-21, and this would amply have restocked the areas had the seedlings not been destroyed by logging operations.

PREPARATION OF SOIL.

Whether the crop of *Pinus insignis* be established by planting or by sowing, it is of the utmost importance that the soil be well prepared to receive the plants or the seeds as the case may be.

Where possible, the ground should be ploughed. When ploughing is not possible, then resort should be had to hand-picking. The whole surface should be picked in order that the natural vegetation may be destroyed as thoroughly as possible. To pick merely the spots to be planted or sown is false economy and generally leads to failure.

In the south-western districts of the Cape Province the first ploughing is effected in the spring and the ground is allowed to lie fallow until the autumn, when it is cross ploughed and harrowed. This preparation destroys the natural vegetation, sweetens the soil, and gives it a good tilth. The cost is higher than in the method of giving only a single ploughing and harrowing, but it is well justified by reason of a better growth of the plants, and also by a reduction of expenditure in the subsequent tending of the crop.

For the same reason, the picking should be done in the spring or summer, and the ground allowed to lie fallow until the autumn. As a final preparation it is desirable to hoe the ground just before planting or sowing.

In the midland districts the first preparation (ploughing or picking) is generally carried out during the winter, and the final preparation is given in the autumn just before the planting or sowing is effected.

In the eastern districts of the Cape Province, Orange Free State, and Transvaal these operations are carried out in the autumn and the ground allowed to lie fallow during the winter. In the following summer or autumn, the second cultivation is given, after which planting is carried out.

(The concluding portion of this article will be published in the next issue of the Journal.)

PLANTING AN ORCHARD.

The Correct Method.

Planning the Lay-out.—During June planting and pruning may ordinarily be taken in hand, but as the present season is a late one, nothing can be gained by attempting to start too soon. If the soil has not been thoroughly prepared, rather spend more time on its preparation as newly planted trees cannot be given too good a start. Where there is absolutely nothing more to be done in the way of preparation, planting may then commence, provided the trees have become dormant meanwhile. As regards the arrangement of the trees in orchard formation, it may be as well to draw attention to a common mistake beginners are apt to make, that is, the indiscriminate planting of the various kinds of fruit. A judicious intermixing of varieties is advantageous, as it affords ideal conditions for the successful cross-pollination of blossoms. Apples, however, should be planted together, not in large blocks of one variety, nor intermixed as to cause the grower to travel over the same ground too often to spray or pick. Plant pears together, also peaches, taking care to keep the early ripening sorts separate from the late sorts, and deal with other kinds of fruit in the same way. By doing so, much time and labour will be saved and the cost of production reduced considerably.

System of Planting.—For convenience when cultivating, and for economical working when spraying, harvesting, and pruning, it is desirable that the trees should stand in straight lines; therefore, the "square" system of planting is the simplest and believed by many to be the best.

Before commencing the work of pegging off, the planter should provide himself with a sufficient number of stout pegs (two for each tree to be planted), a steel tape, a good garden-line, planting-board, and three sighting-poles. If a row of trees exists, especially if eucalypts, and is to be used as a boundary line and windbreak, the first row of fruit trees should not be planted closer to it than 60 feet. If the windbreak is composed of pines or cypress, 40 feet would be sufficient. The base line, which is usually the longest stretch, is pegged off first; then the two side lines are struck and squared by the 3.4.5 method. The side lines may then be pegged off at the required distances, and the intervening spaces pegged off by stretching the garden-line between opposite pegs.

To make a planting-board, obtain a piece of board 1½ inch by 4 inches and 6 feet long; in the middle of one side of the board cut a V-shaped notch; from the point of the V measure off on each side 2 feet—cutting similar V-shaped notches at the two points. It is essential that the measurements and cuts be exact. Place the board

so that the centre notch is immediately behind a peg marking the site of a tree. Now place a peg or stick in each of the other notches, pressing or driving the pegs into the ground sufficiently firm so that they cannot be easily knocked out of place. Withdraw the centre peg and remove the board—there are now two pegs 4 feet apart. To dig the holes for the trees remove the ground from between the two pegs, keeping the top soil separate from the sub-soil, but taking care that neither of the two pegs is disturbed and that the soil excavated will not interfere with the replacing of the planting-board.

After the holes are dug out, a bucket of water can be turned into each to provide moisture at that depth. The holes can then be partly filled with soil and more water added; this will moisten the soil which is to come immediately into contact with the roots and be far more effective than applying it, after planting, on the surface only.

When trees are received from a nursery, they should be examined immediately on arrival, and, if the roots are dry, be placed in a bucket of water for an hour or two and then covered over by moist soil. Trees which have become badly dried out and shrivelled on the journey may usually be revived by burying them entirely in damp soil and allowing them to remain there for several days, meanwhile constantly keeping the soil moist.

When taking out trees to plant in the various positions, carry them about with their roots in a wet sack and do not leave them exposed to the sun for even a short length of time.

When the trees are being planted, no manure should be added to the soil, but a little bonemeal can very well be mixed with it, as this does not have any of the harmful effects produced by turning in stable or kraal manure with the soil when planting. Mix the soil at the bottom of the hole where the tree is to be planted, and bring it to a convenient height, so that when the tree is held in position its roots will not be cramped or twisted, and the depth to which they will be covered will be the same, or a little less, as when in the nursery.

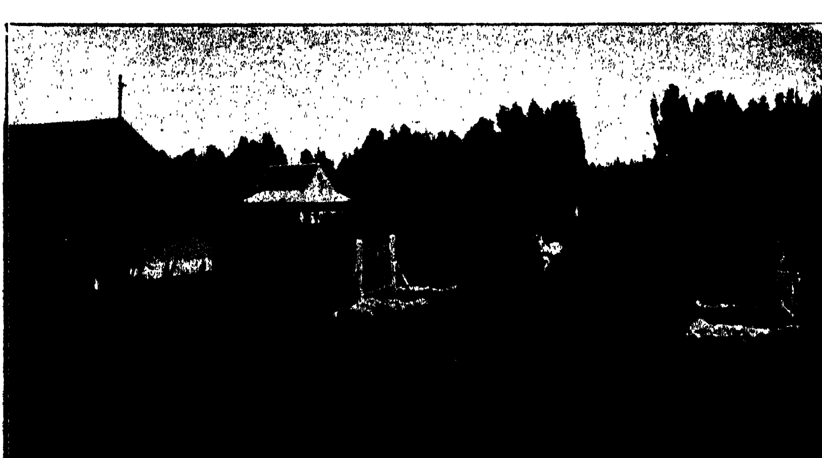
A general fault is to plant too deeply, bringing the bud or graft below the surface of the soil and causing roots to develop from the stem above the bud or graft. Apple trees are grafted on a blight-resistant stock, such as Northern Spy; it follows that planting too deeply will cause development of non-resistant roots from above the graft, entailing almost endless work and worry.

The depth at which a plant has previously grown in the soil can easily be seen by the difference in colour of the bark at the ground-level. As the tree is held in position by making full use of the planting-board, throw in fine soil amongst the roots and gently move the tree up and down a little so that the soil will become thoroughly mixed in with the roots. When the roots have just been covered, tread the soil, and after adding a little more, tread it again. Firm planting must always be aimed at, and if the ground used for mixing about the roots be moderately moist, the trees will soon benefit from these conditions and be able to find a sufficient amount of moisture to prevent any dying back. Fill up the holes to within two inches of the surface, and after seeing that the soil is thoroughly firm, give a bucketful of water to each tree, afterwards covering over the depression with fine, dry soil. A bucketful of water can be given them every seven or ten days, and each day following the ground

should be loosened with a hoe to prevent drying out. A mulch of old rotten manure, or even grass, can be spread around the trees with the same object. After planting is complete, a plan should be made of the orchard, showing where each tree stands. The label should also be removed; too often it is left on and the tie injures the growing tree.

Staking is not advisable, unless a tree shows a tendency to grow lob-sided; in such event the tree should be given a decided lean or pull in the opposite direction by fastening to a stake until the stem straightens. In windy weather see that the tree does not chafe against the stake.

Heading or Pruning.—A young tree as received from the nursery usually carries too much wood, so that it requires to be shortened back. If a single stem, it is best to cut back to within 15 or 18 inches of the ground, thus enabling the young tree to throw out fine, sturdy branches to build up a good framework. Should two or more branches be on the young tree, if well placed, they should be cut back to within 6 or 8 inches of the stem; but if badly placed, it is much better to take out all except the best one and to shorten it back as previously advised. (*Potchefstroom School of Agriculture.*)



THE RUNNING AND MANAGEMENT OF A POULTRY PLANT.

AT the recent Elsenburg Annual Poultry Breeders' Conference, a paper was read by Mr. McArthur, Itinerant Lecturer in Poultry, on the management of a certain poultry farm, situated in the Malmesbury District, Cape Province. It is run as a mixed farm, poultry only forming one of seven main sections, and being managed entirely by the farmer's wife.

The plant covers an area of eight acres, all under permanent lucerne, and is divided into eight camps. Each camp is provided with a house to accommodate 200 laying birds, and is constructed of corrugated iron.

The feeding consists of wet mash early of a morning, a variety of green feed in addition to the lucerne shortly after breakfast, and two feeds each of ¾ ounce of grain each day fed at midday and again in the evening. Grit, shell, and charcoal are always available for the birds.

The incubator capacity of the plant is about 600 eggs, and the chickens are brooded in entirely cold brooders of very simple design. The greater part of the eggs for incubation are obtained from a large pen of 130 hens mated to thirteen cockerels. The stock consists entirely of pure-bred and high-grade White Leghorns, numbering just over 1,000 laying hens.

All eggs are marketed through the Cape Egg Circle, Ltd., and this farm is far and away the biggest individual supplier which the Circle has.

A brief statement of the trading account for the year 1924 will at once show the remarkable state of efficiency which has been obtained:—

Receipts.

Sale of eggs to the Cape Egg Circle, Ltd.				£839	15	5
Bonus at 6 per cent. for the year				50	0	0
Sale of breeding pens, cockerels, setting eggs, older birds culled out, etc.				150	0	0
TOTAL				£1,039	15	5

Expenditure.

Cost of feed	£360	0	0			
Railage on eggs	30	0	0			
Paraffin and sundries	15	0	0			
Labour	30	0	0			
				435	0	0
				£604	15	5

leaving a gross profit over cost of feed and labour of approximately £600.

The success of the plant is attributed to the scrupulous cleanliness always observed, to the production of eggs when eggs are scarce, and to the running of the birds on lucerne. (*Elsenburg School of Agriculture.*)

INQUIRIES AND REPLIES.

SELECTED LETTERS FROM FARMERS.

[Hereunder are a number of recent letters replied to by the various Divisions and Schools of Agriculture concerned. They are selected for publication as being of interest to farmers generally in the localities affected. In each case the area only from which the inquiry emanates is given; as the replies must necessarily be curtailed, they will indicate, when required, literature from which further information may be had. All departmental bulletins quoted are obtainable on application to the Editor.]

Fowl Manure as Fertilizer.

P.O. Simondium, Cape.—What is the fertilizing value of fowl manure?

Elsenburg School of Agriculture replies: Fowl manure differs considerably from that of the more common farm animals. Dry fowl manure contains from 1.8 to 2.1 per cent. of nitrogen, .8 to 2 per cent. of phosphoric oxide, and from .3 to 1.1 per cent. of potash. It is not an ideally balanced manure for all purposes, and is best supplemented by about 350 lb. of superphosphate and 150 lb. of muriate of potash per ton of the manure.

If supplemented in this way, fowl manure can be used in much smaller quantities than would otherwise be necessary. The manure as listed above would be worth from £1. 10s. to £2. 4s. per ton.

Fowl manure composted with leaves, sweepings, and other farm rubbish is also very useful, but such a compost should also be supplemented as explained above. By this means, also, more rotting material is added to the soil.

Weights of Berkshire and Large Black Pigs.

Kroonstad: I have Berkshire and Large Black pigs. Please let me know what weights I should expect at different ages, so that I can judge if my pigs are up to standard?

Glen School of Agriculture replies: The following are minimum weights of pure-bred Berkshire and Large Blacks:—

Age.	Berkshire.	Large Black.	Age.	Berkshire.	Large Black.
1 month	12 lb.	15 lb.	7 months	100 lb.	115 lb.
2 months	25 "	30 "	8 "	122 "	140 "
3 "	38 "	45 "	9 "	145 "	165 "
4 "	50 "	60 "	10 "	168 "	190 "
5 "	68 "	75 "	11 "	190 "	220 "
6 "	82 "	95 "	12 "	220 "	250 "

Storing Farm Manure.

Pomona, Piquetberg.—Kindly advise me on practical methods of storing farm manure to ensure a minimum loss of its valuable fertilizing constituents.

Elsenburg School of Agriculture replies: The practice of absorbing the liquid portion of the manure by a liberal use of sawdust and bedding material is thoroughly sound. The following procedure is also recommended:—

(1) The manure should be kept as compact as possible to prevent rapid oxidation with the consequent loss of nitrogen, the most valuable and expensive constituent of the manure.

(2) The manure should be kept moist.

(3) A 4 to 6 inch layer of soil or peat should be spread over the surface of the manure to absorb any escaping ammonia gas which contains the nitrogen.

(4) The manure heap should stand on a floor suitable for the retention of plant-food material which will otherwise be lost owing to leaching by rains.

Pigs Eating Fowls.

Wonderfontein.—My pigs have been killing and eating any fowls that go into their runs. Kindly advise me on this matter; I fear something is lacking in their food?

Potchefstroom School of Agriculture replies: This depraved appetite is undoubtedly due to a deficiency in the feeds available to the pigs. Pigs feel such a deficiency more keenly than other farm animals, and they are notoriously mismanaged on many farms. Many farmers feed mostly mealies, and this foodstuff is very deficient in bone and muscle building material. Mealies are undoubtedly the cheapest foodstuffs on most farms, but they should always be supplemented by other cereals and green feeds. The pig is a very omnivorous feeder, and can make use of any kind of wastage on the farm.

The best to do in your case would be to feed a ration containing several different feeds—mealie meal 3 parts, crushed oats or pollard 2 parts, at the rate of 2-2½ lb. per 100 lb. live weight. If you have green feeds such as rape, kale, or mangel wurzels on hand, good use should be made of them. Skim-milk for weaners from eight to twelve weeks is very excellent, in fact, almost indispensable. If variety of feed is limited and no green feeds available, feed 2 oz. of good sterilized bonemeal, mixed with the grain feed, per head.

ERRATUM.—In the May issue, the Notes from the Potchefstroom School of Agriculture (Departmental Activities) referred on page 388 to "Lalkasarwali" wheat as a late variety, whereas it is actually an early variety.

NOTES FROM THE "GAZETTE.'

Attention is drawn to the following matters of interest which appeared in the *Union Government Gazette*:—

(Abbreviations: "Proc."-Proclamation. "G.N."-Government Notice.)

Gazette. No.	*Date.*	*Items.*
1474	15/5/25	*Citrus Canker.*—The restrictions regarding the spread of citrus canker are now applicable to certain areas in the Potgietersrust District. These areas have been added to the Nylstroom Ward area where the restrictions are already in force. (Proc. No. 107).
1474 1478 1480	15/5/25 29/5/25 5/6/25	*Compulsory Dipping of Cattle.*—The compulsory disinfection and dipping of cattle has been ordered as follows:— (*a*) Every five days in the five-day dip for portions of Pietermaritzburg, Dundee, Estcourt. (*b*) Every fourteen days in the fourteen-day dip for portions of St. Marks. (G.N. No. 822, 821, 865, 894, 933).
1476	22/5/25	*Dividing Fences.*—Contributions towards the cost of dividing fences have been declared obligatory in certain areas of Gordonia District (Proc. No. 111) and in the Albert Division (Proc. No. 113).
1476	22/5/25	*Protected and Semi-protected Areas.*—For purposes of the Scab Regulations the Richmond District, Natal, has been declared a semi-protected area (G.N. No. 831).
1478 1480	29/5/25 5/6/25	*Disposal of Crown Lands.*—Various Crown lands are to be sold by public auction as follows:—Swellendam Division, in the Karnemelks River Field Cornetcy, at the Rietkuil Outspan, Swellandam, 11 a.m., 25th July; Caledon Division, in the Upper River Zonder End Field Cornetcy, at 11 a.m., 15th August, at the Court-house, Villiersdorp; in the Division of Hanover, at 10 a.m., 22nd August, at the Magistrate's Office, De Aar; in the Waterberg District, at 10 a.m., 10th July, at Messrs. Budler & Meintjes' offices, Nylstroom. Particulars of the above land are obtainable from the Secretary for Lands, Pretoria (G.N. Nos. 879, 881, 947).
1480	5/6/25	Application for various holdings in the Waterberg District must be made to the Secretary for Lands, Pretoria, before the 17th July, 1925. (G.N. No. 943).
1480	5/6/25	*Repayment Fencing Advances.*—A levy for the repayment of advances on certain dividing fences in the Matatiele District has been imposed and dates of payment fixed by Proc. No. 122. *Agricultural Produce Export Regulations.*—These regulations have been amended to include provisions respecting the quality of the containers for maize and kaffir corn intended for export. (Proc. No. 128).
1480	5/6/25	*Importations of Grass and Hay into Basutoland.*—Certain conditions have been prescribed for the introduction of grass and veld hay from certain areas in Natal, and for teff hay, manna hay, and sudan grass hay from other areas outside the Territory (H. Com. Notice No. 103, *Official Gazette* No. 1242).

STAFF: APPOINTMENTS, CHANGES, ETC.

4/2/1925 *C. V. E. Mare, B.V.Sc.*, appointed Government Veterinary Officer, Division of Veterinary Education and Research, Onderstepoort.

4/2/1925 *W. J. B. Green, B.V.Sc.*, appointed Government Veterinary Officer, Division of Veterinary Education and Research, Onderstepoort.

4/2/1925 *J. I. Quin, B.V.Sc.*, appointed Government Veterinary Officer, Division of Veterinary Education and Research, Onderstepoort.

4/2/1925 *M. Bergh, B.V.Sc.*, appointed Government Veterinary Officer, Veterinary Division, Middelburg, Transvaal.

4/2/1925 *J. G. Williams, B.V.Sc.*, appointed Government Veterinary Officer, Veterinary Division, Barberton, Transvaal.

4/2/1925 *P. S. Snyman, B.V.Sc.*, appointed Government Veterinary Officer, Veterinary Division, Durban, Natal; transferred to Harrismith, Orange Free State, 30/3/1925.

30/4/1925 *T. G. Hesse*, Itinerant Instructor, Tobacco and Cotton Division, resigned.

30/4/1925 *G. J. de Wet, M.R.C.V.S.*, appointed temporary Government Veterinary Officer, Durban.

1/5/1925 *J. G. le Roux*, Itinerant Instructor, Division of Horticulture, Wellington, transferred to Capetown.

11/5/1925 *F. G. C. Tooke, M.Sc.*, temporary Entomologist, Cedara, transferred to Capetown.

MOVEMENTS OF OFFICERS.

Dr. Sinclair, Acting Chief of the Division of Chemistry, has transferred the headquarters of the Division and its personnel to Pretoria as from the 11th June, 1925.

Mr. A. Stead, Senior Chemist, in charge of soil survey work, will also have his headquarters transferred from the Grootfontein School of Agriculture, Cape, and located with the Division of Chemistry, Pretoria.

CITRUS CANKER ERADICATION.

INSPECTION WORK, MAY, 1925.

Farms Inspected—

Rustenburg District (Hex River Ward).—Buffelspoort No. 668, Buffelshoek No. 900, Elandsdrift No. 284, Modderfontein No. 247, Alkington Fruit Farm, Spruitfontein No. 349, Roodekopjes No. 171, Zuurplaat No. 822, Rustenburg Town Lands.

Pretoria District (Crocodile River Ward).—De Kroon No. 420, Krokodel Drift West No. 327, Roodekopjes No. 132, Hartebeestfontein No. 5, Zilikats Nek No. 379, Sandspruit No. 379, Skietfontein No. 382, Vissershoek No. 45, Uitvalgrond No. 584, Middelwater No. 589, Greylings Post No. 111, Wildebeesthoek Nos. 120 and 611, Sjamboks Kraal No. 52, Haakdoornboom No. 370, Klipfontein No. 482, Kruisfontein No. 164, Strydfontein No. 606, Kameelfontein No. 51, Nooitgedacht No. 349, Hebron, Syringbult, and Houtfontein Stads.

Fresh infection found on Buffelspoort No. 668, District Rustenburg: 5 (previously reported infected).

Fresh outbreaks.—Nil.

Total number of trees inspected, 34,307; total number of nursery trees inspected, 11,819; total number of trees found infected, 5; total number of inspectors engaged, 13.

[*Photo* "*Tella*," *London.*

NATIONAL FRUIT EXHIBIT: BRITISH EMPIRE EXHIBITION, WEMBLEY, 1925.

JOURNAL OF THE DEPARTMENT OF AGRICULTURE.

VOL. XI. AUGUST, 1925. No. 2.

Published monthly in English and Afrikaans by the Department of Agriculture, Union of South Africa.

SUBSCRIPTION: Within the Union and South-West Africa, **5s.** (otherwise **6s.**) per annum, post free, payable in advance.
Applications, with subscriptions, to be sent to the Government Printer, Pretoria.

NOTES.

APPEAL OF THE MINISTER OF AGRICULTURE TO THE FARMERS OF THE UNION.

Fighting the Locust.

Fellow-citizens and farmers of the Union of South Africa, I take this opportunity to thank you for your loyal support and co-operation in combating the locust plague during the past season.

With your assistance and self-sacrifice and the expenditure of great sums of money by the Government, we have been able under Divine guidance to rid every part of the Union of voetganger locusts; the crops have been saved, and we may thankfully expect unequalled crops of grain, etc., this year; besides, the pastures have been preserved for our stock.

In the Kalahari, however, with an area of nearly 168,000 square miles, we could not successfully fight the pest, owing to the vast area involved and the scarcity of water, etc.; consequently flying locusts from those parts have entered and are still invading the Union at various points.

My officials are doing all in their power to stem the invasion by means of available motor-lorries; to supply all the threatened districts with these means, was, however, impossible, with the result that the flying locusts have already wrought some damage to crops in

various districts of the Union, where the farmers had to institute a campaign at the cost of great effort and self-sacrifice.

It is also known to me that farmers in various parts had repeatedly to fight the invasion, only to be followed by new invasions. These efforts are greatly appreciated, as I know that repeated invasions are apt to cause dismay and a tendency to become lax. I would, however, make a special appeal to these friends who so often had to stand to arms, particularly now that the battle has nearly been won.

If we are going to rest on our laurels now and allow the locust infestations from the Kalahari to breed within the Union, there is every likelihood of the locust campaign having to be repeated next season, in which event the ensuing sacrifices and distress will far outweigh the effort now necessary to eradicate the few flying swarms in our midst.

As far as my Department is concerned, every possible effort will be made, with the aid of motor-lorries, to fight the voetganger and flying locusts in those areas constantly threatened from the Kalahari. Yet it is apparent that all the locusts cannot thus be eradicated; hence my appeal to my fellow-farmers to persevere to the last, even though it be at some inconvenience. Fighting the locust means warfare against a common enemy; it is, therefore, a question of great national importance.

Knowing my people as I do, I am convinced that my appeal will not be in vain, and that I can fully rely on their further loyal support and co-operation.

J. KEMP,
Minister of Agriculture.

The Origin of the Kolbroek.

Mr. A. Meiring, of Graaff-Reinet, has sent the following interesting letter in connexion with the series of articles on our more important breeds of pigs that have appeared in the *Journal*:—

> "In writing on the breed of the Kolbroek pig (June, 1925, issue of the *Journal*), Mr. Morkel, *inter alia*, says there is some obscurity attached to its origin. I give the following for what it is worth, but it may possibly lead to elucidation:—
>
> "In the seventies, while discussing this pig, Mr. M. J. Jackson (now deceased), special border magistrate, informed me that his late father, a retired Indian officer, who settled at Houwhoek, near Caledon, had told him that, many years ago, a vessel named 'Colebrook' was wrecked on the coast between Caledon and Bredasdorp and that some pigs were washed ashore, which were secured by some farmers, who then bred them, and named them Colebrook."

Inquiries are being made in regard to the ship mentioned by Mr. Meiring. The Department would welcome further information from any one who might be able to throw light on the obscurity surrounding the origin of the Kolbroek.

Professor Webber's Pronouncement on our Citrus Industry.

The eargerly awaited report of Professor Webber, the eminent American scientist, who recently visited South Africa at the instance of the Government for the purpose of inquiring into the methods and practices pursued in connexion with our citrus fruit industry, is now on the eve of publication, and application for copies thereof should be made to this office, with the requisite remittance.*

Every facility was afforded Professor Webber to get to the heart of things, and that this was achieved is evidenced in the comprehensive and valuable report that he has been enabled to make. It is, of course, not a complete detailed treatise on our citrus industry, but it is nevertheless a lengthy document pregnant with helpful criticism and advice that every citrus grower would do well to consider.

It is pleasing to learn from Professor Webber that he found his visit to our country not only interesting and enjoyable, but that, in giving us the benefit of his ripe experience, he has, in turn, learned many things that may be of value to his own country.

Professor Webber's considered opinion is that the outlook of citrus growing in South Africa is very promising if growers will co-operate to push the industry and extend the markets, for co-operative advertising and marketing is a necessity. He urges growers to be self-reliant and not to depend too much on Government agencies to do things for them. The organization of a citrus institute or association to meet at regular intervals for the discussion of important problems of the industry is strongly advocated.

He points out that only a few varieties of citrus fruits should be grown for export, and these should be the best standard types only. Groves of the future should thus be planted to such varieties rather than with seedlings. The Valencia is considered, generally, to be the best orange variety, particularly for interior arid sections, but the Washington Navel should be grown extensively in parts best suited to it in order to supply the early market and extend the season of production. Limited quantities also of certain other varieties will doubtless find a ready market.

Our naartjes require to be better standardized and only the best varieties grown, particularly large fruited types. Further study must be given to grape-fruit to determine the best varieties to grow, seedlessness, thin skin, and better quality being aimed at. Growing lemons for export is not recommended, but the supply for local requirements has room for much improvement.

Production, shipment, and sales costs in South Africa were found to be rather lower than in America. Growers are cautioned, however, not to plant poor lands to citrus orchards or to extend their planting beyond the acreage for which they have water; and water companies, Professor Webber believes, should be owned and controlled by the growers owning the land covered and served by them; while picking,

* "A Comparative Study of the Citrus Industry of South Africa," by Herbert H. Webber, Ph.D., D.Agr., Director, Citrus Experiment Station, and Professor of Sub-Tropical Horticulture, University of California, United States of America, temporarily Special Citrus Commissioner, Department of Agriculture, Union of South Africa. Bulletin No. 6 of 1926, obtainable from this office. Price 2s. prepaid.

curing, and packing should be done by co-operative packing-houses, the benefit of which outweighs any possible damage through transportation of the fruit to these centres.

The report emphasizes several important points to be observed in planting and culture generally. Bud selection is most important in isolating and maintaining the best strains of all standard varieties of citrus fruits, superior strains of such being located from which certified buds should be supplied for propagation. In importation of varieties, only small quantities should be brought in to guard against the extensive propagation of untested and possibly worthless sorts, and the introduction also of disease and pests. The keeping of tree records and the use of grove analysis methods based thereon are recommended.

Professor Webber advises the selection of large, vigorous-growing stocks, of whatever kind used, to ensure good, uniform orchards, and discusses the methods of selection. The rough lemon was found to be the most generally used and satisfactory stock for all types of citrus fruits. The sweet orange also was found to give excellent results, but its susceptibility to collar rot renders its use rather dangerous except in dry, well-drained localities. As a stock the Seville has not proved a success in South Africa up to the present, while for naartjes the naartje stock has proved very satisfactory, and for this fruit is probably superior to the rough lemon.

The improvement of stocks by the selection of large seeds does not appear to be effective. The propagation of budding stock by layering is recommended as a means of security uniformity. Good trees, it is considered, would be secured from the propagation of standard varieties by layering, but it would mean that they were being grown on their own roots, which are very susceptible generally to collar rot; moreover, this practice would enable only a minimum application of bud-selection methods, and this is not entirely satisfactory.

Continuous clean cultivation is considered injurious unless accompanied by heavy fertilization with bulky organic manures, and many of our groves are believed to require much heavier fertilization or manuring than is being given them. Kraal or stable manure is recommended, but if manure cannot be obtained in sufficient quantity, lucerne hay, bean straw, or similar materials may be used as substitutes. Growing cover crops as green manures is recommended as valuable in adding fertility and improving the soil. The effect of fertilizers on the character and quality of the fruit is claimed to be very slight and of little practical importance.

The phosphoric acid potash and lime requirements of individual groves should be determined by experiment by growers in their own groves.

Methods of fertilizing are discussed, and the broadcast system is preferred to the trench and mulch basin methods.

In regard to irrigation, Professor Webber states that all of the soil should be wetted, but the water should not come in contact with the tree trunks. He animadverts on our methods of water distribution. Our furrows run too long a distance—600 to 1,200 feet—the most satisfactory distance being 300 to 400 feet. Another common error is to lay out the orchard in such a manner that the grade or fall of the furrows is too great to obtain a good water penetration, or in such a way that the furrows are variable in grade, so that a

uniform penetration of the water cannot be obtained. Contour planting is emphasized as the only method of obtaining furrows of uniform grade on hillsides and thus of securing a uniform and satisfactory irrigation of the groves so situated.

Severe pruning of any type of citrus tree is condemned as injurious, in the belief that the orange requires little pruning other than the removal of dead or diseased limbs and interfering branches too close set.

Professor Webber found collar rot, the most dreaded of citrus diseases in many districts where the methods of prevention or control in general were very poor, and he furnishes valuable advice on the treatment of the trouble.

Budding high, that is, eight to ten inches above the ground, is recommended as a preventive measure against collar rot. Deep setting, a common error in orchard planting, is also conducive to collar rot and other diseases. Psorosis or scaly bark, a very serious disease in American orange groves, was not found to any extent, and its eradication is urged. The occurrence of the citrus nematode or eel worm is also referred to. For the control of scale insects, fumigation is believed to be more effective and just as cheap as spraying.

An important subject dealt with is the excessive fruits drops of Washington Navels, which are believed to be due to adverse conditions; as a corrective, good fertilization, good irrigation, and good pest control are recommended. An extra fertilization just before the flowering period with quickly available nitrate, such as nitrate of soda, is recommended for trial.

These and other matters are discussed at length by Professor Webber in his report (which is well illustrated). Altogether he presents an outstanding treatise on the most important aspects of an industry which, in his judgment (and it is that of one of the highest authorities living), is very promising. The future, Professor Webber remarks, lies with the grower himself, and it is trusted that the advice and methods so plainly set out in the report will receive the earnest consideration of all who have a stake in the citrus industry of South Africa.

Our Cattle Industry: A Fresh Start.

The position of our cattle industry has received considerable attention in recent years, largely urged on by the press of economic factors. Various remedies and policies have been proposed, much thought being given particularly to the disposal of our surplus supply. The solution of that phase of the question would, of course, bring a much-needed relief. But the problem of the industry is of deeper import: it calls for improvement in the quality of our live stock. To achieve this end, two main things appear to be necessary—thorough organization amongst producers, and a better knowledge of animal husbandry, particularly in respect of proper feeding methods.

The successful progress of dairying in South Africa would largely solve the problem, for out of it would be born an encouragement to the farmer to invest in a better class of animal, which, in turn, would lead naturally to a better knowledge of the proper care of his animals and of correct feeding. But our dairying industry is to-day in an unhealthy condition. There are too many scrub cows and too

many under-fed ones. There is too little all-the-year-round production, and the creameries therefore are without supplies or very short thereof for a great portion of the year; their overhead expenses, however, continue and must in the end be met by the producer. And in proportion to our output there are too many creameries.

Unfortunately, improvement of present conditions cannot be expected in too short a space of time. To induce it, much education is needed. There are, for instance, only a small number of farmers who have availed themselves of the facility provided by this Department in its system of milk-recording, which is the only sure way to the elimination of the scrub cow that does not pay for her feed, and so renders the herd unprofitable. Milk-recording has at all times been strongly advocated as an essential in profitable, business-like dairying, and has been one of the main factors in the establishment of the dairy industry in Denmark.

Which is the best breed for any particular locality? What method of handling is best suited to our conditions? What is the most suitable feed in various areas? These are questions still to be answered. And only when they are definitely answered can we expect to proceed uninterruptedly on our way to healthy expansion.

Steps are now being taken by the Department to lay a foundation whereon the country's cattle industry (both beef and milk) may be securely established. The corner stone of this foundation is a knowledge of our true position and of the live stock we possess. To secure this very necessary preliminary information, the Director of Field and Animal Husbandry has sent a specially prepared form to every farmer in the country, asking for its return duly completed. It is neither a lengthy nor complicated form, and can without difficulty be completed by every farmer. It asks in respect of each farm for the number, etc., of (*a*) pure-bred pedigree stock, (*b*) grade stock, (*c*) cattle of no particular type, (*d*) trek oxen, and (*e*) oxen for beef-raising solely; in addition certain particulars are requested in regard to the type of veld and its carrying capacity, and the system (if practised) employed in feeding (apart from grazing) the live stock.

With this information, the first real cattle survey of the Union will be possible. It will make known the position of our pure-bred stock and pave the way to inquiries as to the cause of the non-registration in the South African Stud Book of so many animals. We have need of all our pure-bred stock, yet many such bull calves are sent to the butcher because raising them to maturity is said to be unremunerative.

Then the breeds predominating in various localities and the reasons therefor will be revealed, also in respect of grade stock and animals of no particular type. It would show where sales of pure-bred stock could, with advantage, be held, and so lead to that improvement in the treatment of live stock that would naturally arise from the possession of better class animals.

Many improvements in the industry would follow. Knowing the true position would make possible the formation of producers' associations for the supply of any given number of animals for beef; it would reveal the value of particular types of veld for cattle raising, indicating whether the value of the land is too high, for instance, in proportion to its carrying capacity to raise beef economically. These and other essential points in business-like cattle farming would

become available to those in the industry. But one thing is clear: no spectacular scheme leading to rapid improvement can be launched by the Department. The deliverance of the farmer rests primarily with himself. The cattle industry has grown through the course of years, unguided and almost haphazardly, to its present position. It must be directed into right lines, and this can only be done by laborious, patient endeavour.

The national stocktaking of our animals and methods now being attempted is necessary. The Department appeals, therefore, to every farmer to do his share in making the attempt successful, for no other way of putting the industry on its feet can be devised. It must be built up systematically. Unless the farmer responds to the appeal and furnishes the basic information to make this possible, the present unhappy and unhealthy state of the industry is likely to continue indefinitely.

The form referred to above has been issued with this year's Census form to every farmer, and should be completed and returned without delay. Where any doubt exists as to how the form should be filled in, inquiries made to this Department will gladly be answered.

It is hoped to convene at an early date a meeting of representatives of all cattle breed societies, and a preliminary communication is being sent to them in this connexion, outlining the Department's proposals and requesting the submission by these societies of germane matter for discussion at the meeting. As a result of this meeting it is expected to inaugurate a "National South African Cattle Breeders' Association," on similar lines to those adopted at the recent congress held at Middelburg, Cape Province, in connexion with the Union's sheep industry.

Export of Seeds and Plants to Ceylon.

The Department of Agriculture of Ceylon has adopted stringent restrictions on the introduction of plants and seeds. It is required that introductions enter through certain ports and that plants be accompanied by an inspection certificate issued within fourteen days of dispatch. In the case of plants from South Africa, the certificate must be from the Department of Agriculture. Any one who wishes to send plants or seeds to Ceylon should communicate with the Chief, Division of Entomology, P.O. Box 513, Pretoria, stating just what he proposes to send.

DEPARTMENTAL ACTIVITIES.

(NOTE.—The work of the several Divisions and Schools of Agriculture covers a wide range of agricultural industry in the Union, and we give hereunder notes and observations from certain of them treating with matters of special interest coming under their purview month by month. The object of these notes, which are not concerned with general routine work, is to inform the farmer of such matters as are calculated to be of interest and helpful to him.—EDITOR.)

THE DIVISIONS.

DIRECTOR OF VETERINARY EDUCATION AND RESEARCH.

Obscure Disease in Lambs.—Reports of an obscure skin disease affecting this year's lambs, have come to the notice of this Division. Outbreaks have been reported from various centres in the Union, e.g., Bechuanaland, Aliwal North, Dordrecht, Winburg, Bethlehem, Trompsburg, Western Transvaal. The disease seems to have made its appearance in the early winter and to have affected lambs from a week old to several weeks and even older. Recently the Division was afforded an opportunity of investigating it in fresh cases, and it was shown that "steekgras" (*Aristida*) was responsible for this condition in lambs.

Arising out of earlier investigations the important factors to be noted are:—(*a*) The enormous increase of Aristida grasses; (*b*) the mechanism for the attachment of the seeds of such grasses to long-woolled sheep (Persians and Africanders do not seem to become affected); and (*c*) the harmful effects produced *on* and *in* the skin by the seeds, and the loss of condition.

As regards preventative measures, it is suggested:—(1) Keeping sheep on veld free from "steekgras"; (2) shearing and dipping *adult* sheep affected with "steekgras" in a lime-sulphur bath; and (3) controlling Aristida grasses on farms by mowing, by cultivation, by close-grazing, and paddocking.

In the case of lambs under investigation, very extensive skin-lesions were observed in the form of multiple abscesses, and the presence of "steekgras" seeds, either in the wool, or in the abscesses, or in the subcutaneous connective tissue. On the surface of the skin, stretching along the back from the head to the tail, the wool was matted together into large hard masses. These lesions *on* and *in* the skin result from a purulent inflammatory process caused by pus-forming micro-organisms carried into the skin by the grass seeds. This condition must be very painful, and lambs die of a toxaemia, complicated with anaemia and poverty.

Keeping newly-born lambs and young lambs on veld free from "steekgras" is probably the only important and practical method of dealing with this disease. It is not known whether washing young lambs in a lukewarm lime-sulphur dip will be practical and have the same beneficial effects claimed for such treatment in adult sheep.

ENTOMOLOGY.

Fruit-piercing Moths.—An interim report has been submitted by Mr. D. Gunn, Eastern Province Entomologist, relative to the serious damage done by fruit-piercing moths in the eastern Cape districts, and the baiting methods employed for destroying the moths.

Most of the mischief would appear to have been due to the moth known as *Achaea lienardi*, and it is reasonably suspected that the moths present in certain orchards towards the latter part of the season were from caterpillars which were noticed during April feeding on the native tree known as bongesa or bloubos or monkey apple (*Royena pubescens*). During that month, in the Bathurst District from Trappes Valley to Kleinmonde, these trees were defoliated by millions of caterpillars and, subsequently, *Achaea lienardi* was reared from a large number of pupae found in the soil under *Royena pubescens* at Kleinmonde.

In the case of this outbreak the moths were found to be active during the day and lent themselves to observation.

During April experiments were commenced with the idea of attracting moths to poison baits. The baits being exposed overnight and removed during the day—and but for a relatively short period—the result seemed to be a failure. Subsequently baiting was tried again, and it was found that the most attractive bait was one prepared to the following formula: Arsenate of lead, 2 oz.; sugar, 3 lb.; grape vinegar, 4 fluid oz.; water, 4 gallons.

Paraffin or petrol tins were cut in halves vertically in the same manner as is done by nurserymen, and twenty ounces of the sweetened poisoned bait placed in each tin. In these and whole tins the bait was set out under the trees near the stems. To make the bait more attractive to the moths, two oranges were cut in half and dipped in the poison for fully a minute; these were then placed with the pulp side up in the tins. In addition to the shallow and deep tins, several coffee and other small tins containing bait were hung up in the trees to ascertain in which tins the bait would prove to be most attractive to the moths.

As arsenate of lead powder forms a precipitate, the tins had to be shaken each morning when the dead moths were removed. It was only necessary, however, to renew the bait in the tins once a week.

The moths appeared to be attracted to the trees under which tins had been placed, and after fluttering for a few minutes in the vicinity, one or two would descend upon the poisoned oranges with the pulp exposed and feed upon them and afterwards upon the liquid bait. The average number caught daily in each of the shallow tins was 75, although over 150 were frequently caught in similar tins placed near native bushes and trees grown as windbreaks.

During visits to orchards in different parts of Bathurst District, it was observed that the moths were so numerous that much of their mischief was accomplished during the daytime, especially until about the end of May before the weather became cold. From the time the bait was exposed at Clumber it was found that fully 75 per cent. of the moths destroyed had been attracted to the bait in the shallow tins, the remainder to that in the deep tins; but none were caught in the small tins which were hung from branches in the trees. Until 12th June, when the last observations were made, thousands of fruit-sucking moths had been caught in an orchard belonging to

Mr. M. H. Rix. Here the work was so successful that less than ½ per cent. of the citrus fruit was injured. In other citrus orchards, more especially those situated near dense native bush, where no control work was undertaken, the losses caused by the moths varied from 15 to fully 50 per cent. Upon visiting a citrus orchard near Port Alfred, the moths were found so numerous that they reminded one of a swarm of locusts.

Mr. A. J. Elliott, Kleinmonde—whose orchard is surrounded with thousands of native bushes and trees, including the bongesa—was successful in destroying thousands of fruit-sucking moths, and saving his oranges from total destruction. He and a number of helpers augmented the baiting by visiting the orchard early each morning, during May; after shaking citrus trees large numbers of moths, which had sheltered in them overnight and which were affected by the cold weather, would drop to the ground where they were killed by striking them with flat pieces of wood.

Eucalyptus Snout-beetle.—The following note upon the distribution of this insect has been received from the Forest Department. One larva and a number of egg-capsules have been found on *Eucalyptus viminalis* coppice in the arboretum of the Fort Grey Plantation, near East London. So far the insect has not been recorded from Zululand, but has been seen at these further localities in Natal: Nottingham Road, Bulwer, Xumeni (near Donnybrook), York, and Ingwangwane (near Riverside). The Natal Conservator of Forests is of the opinion that, probably with the exception of the colder parts, there are few places in the Province where the beetle does not occur.

THE SCHOOLS OF AGRICULTURE AND EXPERIMENT STATIONS.

GROOTFONTEIN, MIDDELBURG, CAPE.

"Hibiscus cannabinus."—This plant is extensively cultivated in India for its fibre which is used for the same purposes as jute (see article by Dr. Pole Evans in this *Journal*, September, 1920), and its possibilities as regards South Africa are now being investigated by the Division of Botany in collaboration with this Institution. During the past season a trial plot at Bathurst produced fairly satisfactory results. On account of the drought in the early part of the year the seed was sown only in March. At the time of harvesting, at the end of June, the plants varied from about two to eight feet in height, the smaller ones growing on a somewhat exposed, windy slope, the larger in a sheltered hollow. A very large proportion of the seed-capsules was destroyed by worms, and very little seed could be collected. It remains to be seen whether this will be a normal factor to be reckoned with. The leaves also were riddled with holes during June, probably due to fungus attack, but this occurred too late in the season to have any effect on the growth of the crop. Though it has been shown that the plant will grow well in the coastal districts, data as regards the value of the fibre produced, the yield to be normally expected, and the best conditions of culture have to be accumulated before it can be recommended as a staple crop for the area.

Locust Egg Parasite.—On the 25th of March, 1925, it was reported that locust eggs were hatching in a sandy tract of land to the north of the school buildings. The locusts were found to be hatching out in large numbers, and dark grey flies slightly larger than house flies were observed walking over the surface of the ground between the small holes from which the locusts were emerging, and frequently entering these holes. They entered them backwards and remained in the entrance with their heads just on a level with the surface of the ground and their legs and wings moving in an excited manner for one or two minutes.

The wings of this fly when at rest are folded over each other, further than those of most flies, so that their tips do not catch on the edge of the holes as they back into them.

Several of the holes were opened immediately after the flies had left them and in each several small white fly eggs were found. Many locusts had already emerged from the holes judging by the number of small white cast-off skins (the amniotic membranes) lying around them.

No further locusts seemed to be emerging from them at the time the flies deposited their eggs in them, but there were still a number of unhatched locust eggs in the bottom of these holes.

On opening a number of other locust egg-packages several were found which had small fly maggots in them. These packages had about half of their eggs still unhatched. The fly maggots did not seem to be attacking the locust eggs, however, but were feeding on the soft damp material of which the egg package was made and on the remains of the frothy material with which the package had been closed.

A quantity of egg packages was dug up together with the fly maggots and brought into the laboratory and kept in damp sand in a glass box.

The maggots developed slowly, feeding on the egg packages.

Ten of the maggots had become fully developed and pupated by the 22nd April. The others had disappeared.

It could not be definitely seen whether they fed on the locust eggs, but after the maggots had developed and pupated the eggs were dug up and carefully examined. Some were found to be shrivelled up with their shells torn open along the sides. It appeared as if the maggots had destroyed them.

On the 27th April, the adult flies began to appear and by the 4th May they had all emerged.

Specimens were sent to the Border Entomologist, who identified the fly as *Stomatorrhina lunata* Fabr. It appears that it is a wide-spread species; it was reared from locust eggs in Pretoria some years ago.

The Senior Locust Officer of this district has brought in a large number of the puparia of this fly, and states that they are very abundant in certain parts of his area. He believes that this parasite is destroying large numbers of locust eggs.

Several farmers have also noticed the flies and written to this Institution for information concerning them.

Wool Growers' Association Competitions.—The report of the committee appointed at the Wool Conference in 1924, to control the competitions between wool growers' associations for an annual trophy in each Province, was considered at the Wool Conference recently held at Middelburg.

This committee recommended that in order to obtain an exhibit of fleeces fully representative of each district, wool growers' associations or branches of the Transvaal Sheep Farmers' Association in the same administrative district should in future combine to compete for the inter-district trophy, and that 50 fleeces of the best wools should be selected from the inter-district exhibits to compete in the inter-provincial competition.

These proposals are being submitted to the various associations at an early date, and will be considered by the Executive Committee of wool growers' organizations, of which Mr. G. Rood, P.O. Somerset East, has been appointed secretary.

Fruit-growing in Venterstad.—During June a pruning demonstration was given in Mr. Bergh's orchard, near Venterstad. The methods of pruning apple, apricot, and peach trees were fully dealt with. Considerable interest is being shown in this district in horticultural matters. In the orchards visited the trees were making very satisfactory progress, but it would appear that during some seasons considerable damage was done to the blossoms or young fruits through late frosts.

POTCHEFSTROOM, TRANSVAAL.

Short Course in Tobacco, Cotton, and Citrus.—Last year this course was successfully given at Rustenburg. It was decided, however, to hold the course this year in the Barberton District, the other large centre for these crops. Nelspruit was chosen as the most central locality, and this seems to have been justified, judging by the attendance, viz.:—

	Men.	Women.	Diploma Students.	Total.
Attendance, 1924, Rustenburg ...	55	4	25	84
Attendance, 1925, Nelspruit	52	4	27	83

Eighty of those taking the course were farmers, settlers, or students. It was one day shorter than advertised, due to the Prince of Wales's visit to Barberton on 16th June, when the whole district turned out to see him. Most of the lectures missed on this day, however, were made up on the rest of the week. One whole day was given to demonstrations in cotton, snuff-tobacco, citrus and tropical fruits on the Tomango Estate. The Department is greatly indebted to Messrs. H. L. Hall & Sons for putting their estate, which is both beautiful and profitable, at its service for the day. This farm is in effect the experiment station of the low veld. The orchards, the nursery, the lemon and orange squash and candied peel factory were not only viewed and everything explained, but the good products were also freely sampled.

In addition to the above demonstrations, the following lectures were given:—Cotton seed selection (2, Mr. Parnell); cotton, general (4, Mr. L. Worrall); tobacco (5, Mr. Mansvelt); citrus (5, Dr. R. Blatt); tropical fruits (2, Dr. R. Blatt); soils and fertilizers (3, Mr. Thos. B. Hall); deciduous fruit (1, Mr. H. B. Terry).

Those people taking the course seemed very interested. The mayor, town clerk, and village council were helpful in every way, seeing about the pitching of tents, and putting their fine new hall at our disposal. The Barberton District Farmers' Union and the Low Veld Farmers' Association were also of great assistance. A most enjoyable dance was given, and altogether the course was not only profitable but very pleasant.

The district is anxious to have the course there again next year; the farmers' associations have offered to circularize their members, and guarantee a greatly increased attendance.

Demonstration in H. L. Hall & Sons' Mango Orchard at Tomango by Mr. H. L. Hall, Mr. L. Hall, and Dr. R. Blatt.

Variation in Percentage of Butter-fat in Cream.—This time of the year farmers sending cream to the creamery often complain of the variation in percentage of fat. Many dairymen think that the percentage of fat should be constant; but this is not so. The factors affecting fat-percentage in cream are:—(1) Percentage of fat in the milk; (2) temperature of milk; (3) variation in the speed of the separator; (4) rate at which milk flows into the machine; and (5) amount of skim-milk used in flushing the bowl.

The percentage of fat in the milk has a certain effect on the richness of the cream; where milk this time of the year is richer in fat, it will influence the percentage of fat in the cream.

The temperature of the milk should be about 90° to 95° F. for the best results. If much lower than this—and this is very often so during the winter months—the separator may not do good work and a richer cream will result, but there will be a loss of cream in the skim-milk.

The speed of the separator should always be uniformly maintained. If the speed is too low a larger amount of cream will result, but with a lower percentage of fat. If the speed is too high, it will give a smaller amount of cream with a higher percentage of fat.

Sugar-beet Investigations.—Sugar-beets play a very important part in the agriculture of Europe and America, and lately also of England. For the past two seasons this Institution has been carrying out experiments to ascertain whether the crop can be produced successfully. The experiments were carried out in co-operation with a number of farmers, mostly on the high veld and in the District of Potchefstroom, with the assistance of Mr. H. A. Biden, of Johannesburg, who has generously donated the Institution seed and money to the value of over £350, and who has lately given a valuable polariscope, an instrument used in determining the sugar-content of the roots.

So far the results have been very satisfactory. Even during the summer of 1923-24 excellent crops were produced on dry land. The yields ranged from 10 to 17 tons of trimmed roots per acre, the sugar-content ranging from 17 to 20 per cent. in Standerton District, 16 to 18 per cent. in Bethal and Ermelo, 14 to 17 per cent. in Potchefstroom and Vereeniging, and 14 per cent. in Pretoria. These yields and sugar-contents, compared with those obtained in Europe and America, are very satisfactory.

The crop requires a large amount of hand labour and attention. Comparison of cost of production with the value of the crop is therefore important. Records kept for the summer of 1923-24 showed a cost of from £4 to £9 per acre. Roots containing 16 per cent. sugar are worth about £1 per ton at the factory. As the percentage of sugar increases the value per ton of roots also increases. As a crop, sugar-beets will, therefore, compare favourably with most of our present farm crops.

The investigation revealed a very important advantage we possess over other beet-sugar producing countries. Owing to our mild winter the roots can be left in the soil throughout that season without any deterioration taking place, and taken up as required. This will enable a mill to work from the end of April till early in August—nearly four months. In Europe and America the roots have to be lifted before the winter, because they are injured by the extreme cold, and the milling season is therefore limited to three months at the most. Our dry winter, and dry climate generally, may enable the farmer who is distant from the factory to dry the roots somewhat, and thus lessen the cost of transportation. Experiments in this connexion are at present in progress. The results from some preliminary trials are very promising. The analysis of several dried beets showed that the process of drying did not affect the sugar-content detrimentally, either in quality or quantity. Indeed, it appears that the quality of the sugar was actually improved.

All results of the experiments carried out last season are not yet to hand. We have every reason to believe, however, that they will be as satisfactory as the summer before.

THE GREAT DROUGHT PROBLEM OF SOUTH AFRICA.

II.

Foretelling the Rainfall and Retaining it when it comes.

NO FALLING OFF IN THE RAINFALL AVERAGE.

HAVING given a great deal of time to investigating whatever records were available, even to studying the record of nature shown in the width between the marks or rings made every year of growth on our old indigenous trees—evidence of periods when the rate of growth was greater than at other times due to variations of rainfall and temperature—the Commission could find nothing to indicate that there has been any appreciable alteration in the rainfall of South Africa, and is satisfied that the average now is no different to what it was a generation ago. At the same time, the often discussed matter of "rainmaking" was inquired into, and some of the schemes for inducing rain were found to be worthless, while others were considered of sufficient importance to call for an authoritative statement as to their feasibility or otherwise. At any rate, one thing is clear, and that is that at present great uncertainty prevails as to what rainfall can be expected during any season. But the farmer always hopes for a normal season, and, indeed, speculates on it by stocking his farm to an extent that only a favourable season would justify Then, as so often happens, a drought comes, bringing loss (and suffering) to the over-stocked, over-grazed farm. And as there is no proved method of "rainmaking," to bring the much-needed rain when it is overdue, the only way of curbing this misplaced optimisim of the farmer, or of placing it on a basis of reason, is to have a system forecasting the rainfall that may be expected each year, which will enable him to plan his season's operations accordingly and with more certainty than at present. For instance, if he is reasonably certain at the beginning of winter that the following summer is likely to be late or dry, he could at once take steps to reduce the number of his stock, and so conserve sufficient grazing and water for his smaller flocks. Such forecast would be a boon to the intelligent farmer, whether it be in guarding against the evils of overstocking or of helping him to decide upon the prospects of sowing certain crops to give an adequate return. Forewarned is forearmed. In some parts it is the practice to look to cattle for returns in wet years, and in dry years to sheep, and thus any means of enabling the farmer to decide beforehand upon his plan of farming for the year would eventually benefit the whole country.

FORECASTING IN SOUTH AFRICA.

Is it possible to make these seasonal forecasts for South Africa? This was an important point to decide upon, and the Commission accordingly investigated the methods employed in other countries in giving weather forecasts. They found that many phenomena are brought into calculation in making such forecasts. It is a prodigious task, but one which the science of meteorology is overcoming. Having ascertained what has already been achieved successfully in this direction in other parts of the world, and being assured of the hopeful possibility of introducing a system similarly successful in South Africa, the Commission has suggested certain lines on which to proceed, which have the backing of eminent scientists versed in the subject. One of these scientists considers that South Africa is very favourably placed, and that our geographical position is so fortunate that we should be fifty years ahead of the rest of the world in the matter of successful seasonal forecasts.

THE FASCINATING THEORY OF CYCLES.

Another matter often discussed by farmers and the Press, that of "cycles," was investigated in this connexion. This idea of cycles holds a fascination of its own, and many theories have been propounded, but the question is so complex and subject to such numerous influences—such as the monthly waxing and waning of the moon, the tides of the sea and the factors that induce them, the imposing of one cycle upon another—that the hope of discovering some simple regular cycle appears remote, while those theories based on the data obtained by the examination of a limited number of years are doomed to early death when put to the test.

But the one thing evident is that forecasts of seasonal variations would (1) minimize losses due to periodic droughts; (2) reduce overstocking, over-grazing, and soil erosion; and (3) increase production. Moreover, this should become possible through extensive continuous study of our climate, and the Commission recommends, therefore, that (*a*) the question be submitted to a committee of specialists to draw up recommendations as to the scope and nature of the necessary observations and study, and the best method of internationalizing the investigation, if this should prove advisable, and (*b*) that the survey of our coast, at present being conducted, should include the recording of observations which, though not necessary from a navigation point of view, may help to throw light on the climate of the Union.

RETAINING THE RAINFALL.

While the successful outcome of these recommendations would certainly go far in helping to remove the incubus that is hampering us so seriously, the much-needed system of forecasting in South Africa is not yet in sight. But whether it comes soon or is long delayed, the farmer in this country of varying climatic conditions and irregular rains will always need to employ every means of conserving the rain when it falls and of putting it to its full use. The water which falls from the sky upon the earth has four possible courses open to it. It may (1) run off the surface and find its way into the water-courses; (2) be evaporated from the surface of the soil

before it is absorbed or even afterwards, if it has not penetrated the soil sufficiently deep; (3) be taken up by the roots of the vegetation and nearly all transpired into the air; and (4) sink so deeply as to strengthen the underground water.

When one sees the great volume of water after rain pouring through thousands of courses on its way to the river and the sea, the first impression is that nearly all the rainfall is running to waste. But that is not so. Expert investigation has estimated that only 6½ per cent. of the rainfall finds its way to our rivers. And, moreover, this is not all lost. It is well known that there are many laws in the Union dealing with the use of these flood waters, and every irrigation farmer has had experience in securing portion thereof for his farming operations. The important question is, "What becomes of the great remainder?" This is of such vast volume that an average year's rainfall would cover the whole area of the Orange Free State to a depth of more than 15 feet. To know what becomes of all this water and how much of it is needlessly evaporated is a problem that appears to be almost impossible to solve with the information we have at present on the subject.

WHAT BECOMES OF OUR RAIN.

In the first place a portion of the water will always evaporate from the surface. Sometimes it may be a very large part; indeed practically all is so absorbed when a light shower is followed by sunshine. The quantity that evaporates depends upon various conditions, such as the temperature of the water and of the air, the velocity of the wind, the extent to which the air is saturated with water-vapour, and so on. Certain of these conditions induce a very rapid evaporation while others have a contrary effect. It is known that one good rain is much better than a succession of light showers, for the former, unless, of course, it is so heavy as to lead to an excessive run-off, penetrates to a greater depth, and is thus protected against the evaporation that follows every rainfall. A moist, warm soil gives rise to evaporation. Moreover the rate of evaporation is higher in a damp earth surface than it is from a water surface. For instance, the evaporation from the exposed water surface of a dam is not as great as that from the same area of warm, damp earth surrounding the dam. Now, if the land is covered by vegetation, it has the means of conserving the moisture in the soil. Firstly, this covering shades the soil surface, and so keeps it cool, which lessens the rate of evaporation. Secondly, it shelters the soil surface from the evaporating powers of the wind. This vegetal covering is important, for it aids the principal factors in the conservation of the rainfall for subsequent use by plants that allow the rain to sink down to the sub-surface layers of the soil. This absorption depends primarily upon the nature of the soil and on the presence of the roots of the vegetation that form channels for the water to percolate down. Thus a vigorous vegetation with a well-developed root system provides the needed channels down which the rain finds an easy entry to the soil. It also means that the rain more quickly disappears from the exposure to evaporation it would be subject to on bare veld, the vegetation thus putting to beneficial use the water that otherwise would in the course of time evaporate from the surface without having served any real purpose. And so an efficient vegetal

covering ensures that the best use is made of the rain that falls on it. Thus it is of such great importance that farmers should, through proper grazing methods, preserve the vegetal covering of their farms and so reduce the otherwise inefficiency of their rainfall.

MAKING GOOD USE OF THE RAIN.

The first purpose should be to retain the rainfall by allowing it to pass from the surface to the sub-surface soils as quickly as possible, but this is gravely retarded by the trampling of live stock, which removes the true surface layer of any soil (to which nature has given the power of being more "self-mulching" than the soil below), and so reduces the power of such soil to conserve from evaporation the rainfall it receives by absorbing it rapidly and passing it down to the sub-soil. This "mulching" of the surface soil is the first great principle of what is known as "dry farming." By it man performs more thoroughly the work of nature in rendering the soil surface better able to prevent the evaporation of the rainfall that has sunk below it. The trampling of stock, however, as mentioned above, leads to the removal, by wind or water erosion, of this surface layer with its natural mulch, reducing the natural power of the soil to retain against evaporation the rain that it has absorbed.

Thus, while a great deal is being done by the State to make use of the proportionately small amount of the country's rainfall that finds its way into the water-courses, the vast volume of water that falls on the surface of the Union largely depends upon the good use that the farmer makes of it. Evaporation plays a far greater part in the dissipation of the moisture of the soil of arid and semi-arid regions than is generally realized. There are constant agencies at work that lead to this evaporation, some of which are beyond the power of the farmer to cope with. But there is one important certain way in which he can help the country. The destruction of the natural vegetal cover leads to increased evaporation, and he must see in his own interests as well as those of his fellow-countrymen, that over-stocking, over-grazing, and the resultant soil erosion are the cause of increased evaporation. Let him fight against these evils, and the decrease in the evaporation that he will thus ensure by providing an efficient cover of vegetation to his veld will not only result in a more beneficial use of the country's rainfall but tend also to strengthen its underground water, while his own farm will materially increase in value.

(NOTE.—For further details read Chapters XVII and XXIII of the Final Report of the Drought Investigation Commission.)

(To be continued.)

BUCKWHEAT.

BUCKWHEAT is strongly recommended as a green manuring crop, as it is quick growing, and generally does better on poor soils than other crops.

Climatic Requirements.—Buckwheat does best where the climate is moist and cool, but it is generally killed by frost. At blooming time it is sensitive to high temperatures and dry weather, especially

Buckwheat six weeks after planting.

when the nights are hot. Hot weather with constant rain is also said to be unfavourable; these conditions at the main flowering time greatly reduce the yields of grain. It should do well on the high veld, but is not recommended as a crop for the lower areas, such as where cotton thrives.

Soil.—As stated above, buckwheat is well suited to poor soils. It responds to good treatment, however, by increased yields, so that when it is grown for grain it would pay to add as much as 200 lb. of superphosphate or bone-meal per acre. Although the growing period is short, the root development is vigorous and extensive, the roots themselves, however, being as a whole of rather delicate structure. The roots are said to be able to extract relatively unavailable foodstuffs from the soil. The soil should be well prepared, as for any other crop, such as maize.

Varieties.—"Japanese" and "Common" are the best varieties under general conditions. "Silverhull" is another variety. It is extensively grown in the United States of America. Seed of the Japanese variety is "pyramid" shaped with hollowed sides, and is dark brown in colour. The "Silverhull" variety has grey-coloured seed, which is better filled and plumper, and the sides are therefore bulgy. The seed should be graded for planting, and the larger seed sown.

Time of Sowing.—Sowing may be done either early in the spring, after danger of frost is past, or else about January or early in February, if necessary. It generally matures seed in about ten weeks and can be ploughed under as a green manuring crop in from five to seven weeks. In a year such as we have just had, one could grow two crops of buckwheat to maturity: such a practice is not to be recommended unless the buckwheat is to be ploughed under.

Sowing.—Buckwheat may be sown with a grain drill or broadcasted and harrowed in. It is generally sown at the rate of about 36-60 lb. per acre.

Harvesting.—When harvesting for grain, it is cut and shocked like wheat, so a self-binder is very useful for reaping the crop. It should be shocked in small shocks immediately after cutting. Buckwheat is usually harvested when the seeds from the first lot of blossoms are fully mature. If frost threatens, it may be cut sooner; indeed, it is often better to cut the buckwheat before the seed is mature, as it shatters less when cut earlier.

Thrashing.—Buckwheat is thrashed either with a flail or by machinery. If a flail is used, the straw should be quite dry; when a thrashing-machine is used, it is modified by the removal of the spiked concave, and by inserting one without or with only a few teeth. The grain is more easily thrashed than that of other cereals. Yields of buckwheat vary from 15 to 30 bushels (5 to 10 bags). The average in the United States of America is 20 bushels. A bag of buckwheat weighs about 160 lb.

Uses.—In the United States of America buckwheat is used extensively as a flour for making girdle cakes (pancakes). It is an excellent poultry food, and is readily eaten by stock. The straw is also an excellent stock feed. It is also excellent as a weed destroyer. It germinates quickly and soon covers the ground. As a soil renovator it has great value. It supplies an abundance of green manure which decays quickly.

It is sometimes used as an orchard cover. When the fruit is ripe the buckwheat can be rolled down to facilitate picking of the fruit.

Buckwheat is an excellent honey plant, and is therefore often grown as a bee pasture. Many flowers are produced on each plant, and one plant may produce flowers for a month or more. (*Potchefstroom School of Agriculture.*)

THE COTTON TRADE.

By C. J. HOMEWOOD, Senior Government Cotton Grader, Durban.

FOUNDATION OF THE COTTON TRADE IN GREAT BRITAIN.

THE cotton trade of Great Britain seems to have had its foundation in the reign of Queen Elizabeth, when cotton was imported from Greece. Spinning was then done in Manchester and was carried on in the homes of the work-people, the implement used being known as the spinning jenny. The cloth was then all hand-woven with a hand-loom. Cotton was gradually imported from other parts of the world, but it was not until the seventeenth century that cotton came from America. The first consignment from that country arrived in barrels, and was looked upon with disfavour, and, it is reported, remained in warehouse for months before being sold.

The main foundation of the spinning industry dates from 1769, when Sir Richard Arkwright invented the spinning machine. A mill was, I believe, erected at Nottingham and driven by horses. Later, other mills were erected and driven by water, and the spinning machine was known as the water-frame.

The erection of these mills was received with anger by the work-people, and one erected near Wigan was destroyed, and Arkwright's patent was upset by the courts. However, he erected new mills in Lancashire and Scotland, and from that time the Lancashire spinning industry has gone ahead and is now one of the foremost trades of the country.

The importation of raw cotton was carried on by general merchants at Liverpool until 1841, when in April of that year the Liverpool Cotton Brokers' Association was formed. In 1883, the Cotton Brokers' Association amalgamated with the Liverpool Cotton Merchants' Association, founding the present Liverpool Cotton Association.

In 1883 Great Britain imported 2,748,000 bales of American cotton out of a total of 4,035,000 bales, whereas for the season 1923-1924 the total imports were just under 3,000,000 bales. The decline in imports is accounted for by the shortage of American crops and the greatly increased consumption in that country. Lancashire has turned to spinning finer counts, where less cotton is consumed, although more operators are required than when spinning coarse counts, and the product is much more valuable.

In Great Britain there are at present 60 million spindles, out of a total of 100 million in Europe, 16 million in Asia, 41 million in America.

Over one-quarter of the total exports from Great Britain are manufactured cotton goods, and more than three-quarters of this export passed through Liverpool.

THE TRADE IN LIVERPOOL.

The Liverpool Cotton Market is the greatest in the world and is the largest market for spot cotton. Bombay market runs a very close second and practically deals in only one style of cotton, but the Liverpool market deals in every kind of cotton that is grown. It is also the largest futures market; no market in the world combines both the spot and futures business in the same way as Liverpool.

The Cotton Association consists of 560 members, representing approximately 260 firms, and the business conducted by these firms can be divided into two categories, merchants and brokers, but a number of the larger firms conduct business under both of these categories.

The importing of cotton is a complicated matter to any one not acquainted with the business and would be very difficult to explain in a short article. The majority of cotton imported at the moment is American, but the importation of other growths is based upon similar lines.

The methods of marketing in America are quite different from those of South Africa, for after the farmer has had his seed-cotton ginned and pressed to approximately twelve pounds per cubic foot he takes his lint to the nearest town and sells it himself, conducting his business mainly in the streets; others forward their cotton to agents, who are known as "factors," who buy the cotton from them or offer it for sale on their behalf. During the war American growers became financially strong, and the smaller growers have now formed themselves into co-operative societies and are marketing their produce in a much more orderly and satisfactory manner. Cotton is bought by either American merchants or by men representing British or other overseas importers. It is then usually graded by these buyers, the majority of whom are men who have been drawn from the Liverpool market and are recognized as the most efficient graders in the world to-day.

The bales are then sent to the nearest seaport town and pressed by a steam compress to approximately 25 lb. per cubic foot. Offers are made by telegraph to overseas merchants by giving details of the grade, staple, and the basis required. The grade is based on universal standards and the staple according to Liverpool ideas of stapling. Almost all purchases are made subject to Liverpool arbitration, it being recognized that their rules and regulations are fair and unbiased and their arbitrators above any suspicion of bribery.

On arrival in Liverpool, the cotton is removed to warehouses and each bale is sampled; the merchant then regrades and/or selects these samples bale by bale into marks or lots and places them against contracts he has previously made, or offers them for sale to Lancashire or European spinners, with whose requirements he is well acquainted.

Spinners are represented in the Liverpool market by brokers, who protect their interests by seeing that the quality of cotton tendered is equal in every respect to the "type sample" or description on which it is sold. When a spinner requires cotton, he communicates with his broker as to the quality of cotton he wants; the broker then communicates his orders to the various merchants and makes a thorough examination of all cotton in the market which is offered. He makes a selection from these lots and submits them to the

spinners, and when the purchase is made the broker receives one-half per cent. commission. From this practice, the spinner at a minimum of cost and trouble obtains the exact cotton he requires at the cheapest price, as out of the large stock usually carried by Liverpool merchants there is the closest competition to effect a sale. The duty of the broker does not end with the actual purchase: he samples each bale, passing same if it is equal to purchase sample; forwards all cotton to mills, either by rail, motor, or canal; passes on the invoice to the spinner, and receives the payment, which he hands over to the seller.

After arrival at the mill, should there be any false-packed, damp, or unmerchantable cotton contained in the bales, the spinner claims from the last seller (Liverpool merchant) for differences in quality or returns all cotton inferior to quality contracted for; the broker again acts on behalf of the spinner.

Disputes on contracts are settled by arbitration, with a right to appeal; disputes on technical matters are usually left to the Board of Directors.

FUTURES.

There are two futures markets in Liverpool, one for American cotton and the other for Egyptian cotton; the minimum quantity that can be traded in is 100 bales American, weight 48,000 lb. net, and 50 bales Egyptian cotton, 36,000 lb. net, trading in both markets being conducted in pence and decimals of a penny per lb.

The American contract at present is based on 1924 universal standards, basis middling, nothing below low middling, equal in colour, and not less than fair staple can be tendered. The Egyptian contract is on the basis of fully good fair Sakellarides, with limitations as to grade. The contracts provide for the delivery of actual cotton, American or Egyptian (no other growths are tenderable), and, unless the buyer closes his contract before maturity, the seller must tender the cotton and the buyer accept delivery. The directors and members of the Liverpool Cotton Association are at present trying to formulate a new contract, which will embody and protect all growths of cotton other than Egyptian, as the latter growth has a market of its own.

The futures market is used by buyers and sellers in every part of the world, and its use is really an insurance against sudden advances or declines in values. The market is used by merchants, spinners, and manufacturers to hedge their unsold stocks or uncovered forward sales of cotton, yarn, and manufactured goods.

The minimum brokerages chargeable for transactions in the futures market are half per cent. for non-members and quarter per cent. for members and associate members. That the existence of such a market is an absolute necessity to the trade was proved very forcibly when the market was closed on 31st July, 1914, owing to violent fluctuations which took place when it became known that war was almost certain. Later, great pressure was brought to bear on the Association directors by merchants, brokers, spinners, and manufacturers to reopen the market so as to save them from heavy losses and possibly financial ruin; this was done with very little delay. The Government had such faith in the Association and its directors that it was one of the few trades in Great Britain that was not Government controlled during the war.

The Association is controlled by a board of nineteen directors, including the president, vice-president, and treasurer, and three directors appointed by the spinners of Lancashire. All these positions, excepting the treasurer, are honorary ones and involve a great amount of work and responsibility.

The rules of the Association are numerous and have been carefully thought out from time to time as the basis on which the trade is carried on.

In past years, the majority of cotton dealt in has been American, but every effort is being made to encourage cotton-growing within the British Empire, Liverpool merchants being prepared to deal in every growth. Their aim is to foster and improve the cotton trade in South Africa as well as in England; they ask no favours, but will import our product and compete with other countries in the world. It is difficult to contemplate how the great cotton trade of Great Britain could be carried on without the wonderful organization which has been built up by the Liverpool Cotton Association.

Tobacco: Points for the Grower.

Rate of Seeding.

1 ounce of tobacco seed contains 300,000 seeds.
,, ,, equals 10 level teaspoonfuls.
,, ,, is sown to 100 square yards of seed-bed, i.e. ten beds of 1 yard by 10 yards each.
1 level teaspoonful tobacco seed for a bed of 10 square yards.

Planting Out.

Placed 2 ft. by 3 ft., one acre would require 7,500 plants, or 15,000 plants per morgen.
Placed 3 ft. by 3 ft., one acre would require 5,000 plants, or 10,000 plants per morgen.

Approximate Yield from a good stand.

Bright tobacco: About 6 plants will yield 1 lb. of dry leaf.
Dark tobacco: About 3 plants will yield 1 lb. of dry leaf.

Type of Tobacco Produced.

Other conditions being equal, bright tobacco is produced on light soils, with light manuring; heavy tobacco is produced on heavy soils, with heavy manuring.

Size of Shedding Required.

About 1 square foot of floorspace for every 3-4 plants, for each story or tier in shed.—(*Tobacco and Cotton Division.*)

THE SHEEP NASAL-FLY.

(*OESTRUS OVIS*, LINNÉ.)

By G. A. H. BEDFORD, F.E.S., Division of Veterinary Education and Research, Onderstepoort.

THE Sheep Nasal-fly is parasitic upon sheep, living in its larval or maggot stage in the nasal cavities of its host. It belongs to the order of insects known as Diptera, which includes all true flies possessing only one pair of wings, and to the sub-family Oestrinae. Included in the Oestrinae are several other species that are parasitic upon various species of buck in this country. All the species have similar habits, and their larvæ resemble each other in general appearance. It is also occasionally known to attack goats, and cases are on record of the larvæ having been found in the eyes of human beings in Europe, North Africa, and in America. Recently we received some larvæ from Dr. G. Schmidt, taken from the nasal cavities of a springbok (*Antidorcas marsupialis*) at Omaruru, South-West Africa; also larvæ from Mr. Chalmers, of the Veterinary Division, taken from the nasal chamber and frontal sinuses of a vaal rhebok (*Pelea capreolus*) along with larvæ of *Gedoelstia hassleri*, Ged., another species of Nasal-fly, which has also been found in the frontal sinuses of Lichenstein's hartebeest (*Sigmoceros lichensteini*, Peters) in Portuguese East Africa and Nyasaland, in the nasal cavities of a sassaby (*Damaliscus lunatus*, Burch.) in Uganda, in a species of antelope in Nigeria, and in an unknown host in Abyssinia (*fide* Gedoelst). The fly is a common pest in Europe, America, Australia, and South Africa, and is also known to occur in other parts of Africa and in Asia.

The only other species of Nasal-fly known to attack domestic animals in South Africa is the Horse Nasal-fly (*Rhinoestrus purpureus*, Brauer). Fortunately, this species is very rare in this country; we have only one record of its having been found here.

Closely related to the Nasal-flies are the Warble-flies belonging to the sub-family Hypoderminae. This sub-family also includes a number of species that are parasitic upon different species of buck, and two species (*Hypoderma bovis*, De Geer, and *H. lineatum*, Villers), are very grave pests to cattle-breeders in both Europe and America. The larvæ of all Warble-flies are known as Warbles. In general appearance they resemble those of Nasal-flies, but their mode of living is somewhat different. The larvæ hatch from eggs laid chiefly on the hairs of the legs of their host, and then penetrate the skin and migrate through the body, eventually becoming embedded just under the skin on the back or flanks. Cattle imported into this country are frequently infected with warbles when they arrive. These are able to live on their hosts until they become full grown, but owing to the sudden seasonal change and climatic conditions,

they soon die after they have left their hosts and pupated in the ground.

DESCRIPTIONS OF THE VARIOUS STAGES OF THE SHEEP NASAL-FLY.

The adult fly (Fig. 1) measures about half an inch in length. The head is brown in colour, and on each side there is a large eye (compound eye). Between the compound eyes there are situated on top of the head three very small simple eyes (ocelli). The mouth parts, like those of other Nasal and Warble-flies, are either rudimentary or abortive. The flies are, therefore, unable to feed. The thorax is brown with numerous small, dark tubercles, which give it a dark appearance. The abdomen is white, variegated with dark brown or black markings. The wings are transparent with brown veins, and when the fly is at rest extend beyond the abdomen. When examined closely it will be seen to be sparsely clothed with hair.

The egg is said to be somewhat curved and kidney-shaped.

The larva (Fig. 2) is at first very small, white, and worm-like in appearance. When partly or fully grown it will be observed that it possesses two dark backward projecting hooks at its anterior extremity, and between these hooks is situated the mouth. On the under surface of the abdominal segments there are transverse rows of small backward projecting spines. On the last segment will be found a pair of conspicuous spiracles, through which breathing takes place. Below the spiracles there is a small lobe with small spines and a small process on each side. The larvæ are as a rule white in colour, except when fully grown, when they possess dark transverse bands on the upper surface of some of the abdominal segments.

The pupa (Fig. 3.)—The pupa-case is formed by the hardening of the skin of the larva, which it, therefore, somewhat resembles, except that it is of a slightly different shape and dark brown or black in colour. It measures just over half an inch in length.

LIFE-CYCLE.

The flies may be present from the beginning of September to May, but they are very seldom seen as they are very rapid fliers when on the wing. They may, however, occasionally be found settling on the walls of buildings or troughs towards dusk, or on sultry days.

After the sexes have paired the females fly to sheep, and being either oviparous or viviparous, deposit their eggs or living young at the entrance of the nostrils of the hosts. The young larvæ crawl up the nostrils, with the aid of their hooks and spines, to the nasal sinuses or even as far as the base of the horns in horned rams and goats, and there they attach themselves by their hooks to the mucous membranes. Occasionally the larvæ have been known to migrate to the cranial cavity and the turbinated bones. Should they enter into the recesses of the latter, they ultimately die as they become imprisoned owing to increase in size. The number of larvæ found in an animal may vary from one or two to a dozen or more. Owing to infestation occurring throughout the summer months larvæ in various stages of development may be found in the same animals. When numerous they have been known to cause the death of their host.

SHEEP NASAL FLY. *Cephalomyia (Oestrus) ovis*, L.

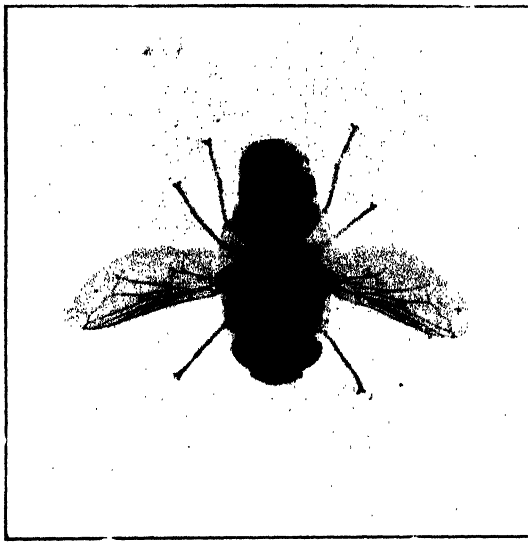


FIG. 1.—Adult Fly, magnified 3 times.

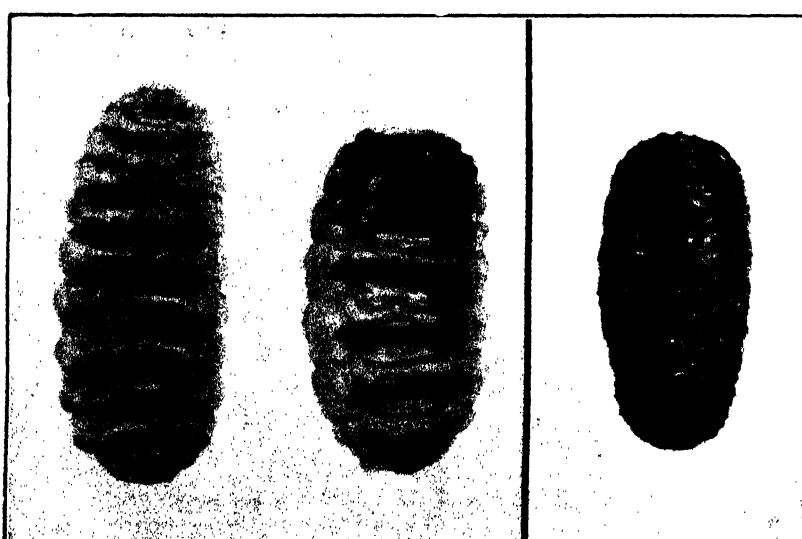


FIG. 2.—Larvae showing dorsal and ventral surfaces, magnified 3 times.

FIG. 3.—Pupa, magnified 3 times.

Mr. J. Spreull, Senior Veterinary Officer of the Cape Province, in submitting larvæ taken from the frontal sinuses of Angora kids in the Murraysburg District, Cape Province, wrote: "A heavy mortality has occurred amongst the kids in the flock, but it is uncertain whether the grubs were the entire cause thereof or only contributory. The sheep and lambs were likewise infected, but did not appear to suffer in the same way." Their presence and their pricking the lining of the mucous membrane cause a considerable amount of irritation. They feed on the secretions resulting from the irritation they set up. The larvæ usually live in their hosts for about eight to ten months, but it would appear that at times they only take about six months to mature, since we have received a full-grown larva from Mr. Spreull taken from an Angora kid not more than six months old. During the period they live in their hosts they undergo several moults, and when full-grown they either crawl out or are expelled by a violent fit of sneezing they cause their hosts by irritation. As soon as the larvæ reach the ground they either burrow into it or crawl into a sheltered place where they pupate.

In South Africa the winter may be passed either in the larval stage in the host or in the pupal stage in the ground, whereas in Europe the winter is always passed in the larval stage.

During the summer months the pupal stage lasts from 21 to 28 days. Should the larvæ leave their host from the beginning of June to the middle of July, then the pupal stage lasts from 49 to 66 days or perhaps even longer, the time varying according to the temperature. When a fly is fully matured and ready to hatch, it breaks off the extremity of the pupal case, or operculum as it is generally called, and escapes. On hatching out it is unable to fly as the wings are wet and folded up. By degrees the wings become spread out, dried and hardened, and while this process is going on, the fly will be observed to blow out its face continually, the blowing gradually decreasing in volume until eventually the face retains its normal shape.

SYMPTOMS.

When the female flies are about, ready to deposit their ova or young, the sheep get very excited and either shake their heads, push their noses into the earth, snort and stamp their front feet violently on the ground, or they may run about with their heads down and noses close to the ground. When they become infected there is a purulent discharge from the nostrils, and the animals may be seen to shake their heads, grate their teeth, sneeze, have difficulty in breathing, or rub their noses on the ground or against their forelegs.

TREATMENT.

Substances such as snuff and pepper may be blown up the nostrils to induce violent sneezing to expel the larvæ, or benzine may be injected by lifting the head and pouring a teaspoonful up each nostril, keeping the head lifted and the nostrils closed for a few seconds. Animals made to inhale the fumes of burning tar and sulphur has also been recommended. As it is usually necessary to repeat the above remedies several times, and as they are not only troublesome, but frequently set up violent irritation in the nasal cavities, and thereby do considerable harm to the animals, it is

suggested that prevention should be aimed at rather than cure. Edmonds states, however, that very satisfactory results have been obtained by injecting a solution of corrosive sublimate, 1 in 1,000 parts of water. A small quantity may be injected up each nostril with a syringe. This should be repeated three or four times at intervals of a few days.

PREVENTIVE MEASURES.

The most practical method, and the one that is usually adopted, is to provide the sheep with salt troughs smeared with tar. When the sheep lick the salt they will get some of the tar on their noses, and this will ward off the flies and prevent them from depositing their eggs or young. A V-shaped trough is the best kind to use. If a trough the sides of which are parallel is used, it should, after the animals have become accustomed to taking the lick, have a board, with holes just large enough for the sheep to put their faces through, placed over it, and tar should be painted round the holes. The troughs should be kept in use during the months the flies are present, i.e. from the beginning of September to May. Infected sheep should be isolated and kept on hard ground, as this will prevent the animals from dropping the larvæ onto the veld and infecting it.

If the ground is examined once or twice daily, the larvæ can be collected and destroyed.

Disinfection of Tobacco Seed with Formalin.

It is possible that tobacco wildfire may be introduced into the seedbed by the use of infected seed; and since even healthy seed may very easily become contaminated by infected dust, chaff, etc., farmers are advised to disinfect all seed before sowing. The following procedure is recommended:—

Obtain a small quantity of "*Commercial 40 per cent. Formalin*" from any reliable chemist. The cost is about 3d. per oz., and 1 oz. will be sufficient to treat 4 oz. of seed. Add 1 part of formalin to 16 parts of water.

Put the seed into a loose muslin bag, dip into water for a minute until thoroughly wet, drain off, and then soak in the weak formalin for exactly fifteen minutes with frequent shaking and stirring. Then wash *thoroughly* with at least four or five changes of clean water, and spread out upon clean paper to dry. When quite dry put the seed back into the dried bag and store it in a place where it cannot become contaminated by old tobacco leaf, etc. Avoid handling too large a quantity of seed at a time. If thoroughly washed, treated seed should remain good for at least three months. (*Division of Botany.*)

THE AMOUNT OF STRYCHNINE IN POISONED FINCHES.

By J. V. CUTLER, Assistant Chemist, School of Agriculture and Experiment Station, Potchefstroom.

THE losses of wheat in the ripening crops, due to the depredations of finches and other small birds, are serious in many of the districts where this crop is grown under irrigation, but especially in the District of Potchefstroom, where losses from 10 per cent. to 90 per cent. of the crop are reported even when drivers are employed, and much money spent on shot in an endeavour to cope with the pest. In 1924 complaints were numerous as to the size of the flocks and the damage done by them.

During the last few years farmers, in addition to paying out considerable sums for bird-drivers, have made a practice of putting down poisoned grain so that the flocks may be reduced and the damage minimized. In this *Journal** Schlupp discussed in 1922 the methods of eliminating these pests, and detailed the preparation of bait by various methods. At this Experiment Station the following formula was used very successfully:—

1½ lb. of flour was mixed to a smooth paste with water, stirred and boiled.

1 oz. of strychnine, *alkaloid*, was then worked in thoroughly.

This mixture was spread over 50 lb. grain (wheat was used in this instance, but millet is far better, and crushed maize is also good), with stirring so that all the grains were evenly coated. The whole is spread out to dry. The seed is thus coated with a dry adhesive coating which seems to mask the bitter taste of the strychnine. The strychnine alkaloid has given far better results than strychnine sulphate.

In one day, with a few pounds of grain thus treated, a thousand birds, practically all finches, were killed, and about fifty were collected at random for the purpose of analysis. The weight of grain found in the digestive tract and the amount of strychnine found in the birds with and without the entrails were determined. The results are tabulated in Table 1.

* See *Journal of the Department of Agriculture*, May, 1922, "The Granivorous Bird Problem," by F. W. Schlupp.

TABLE 1.—*The Weight of Grains and Strychnine found in Poisoned Birds.*

Number of Birds.	Weight of Birds.	Weight of Moist Grain Found in Crops.	Weight of Dry Grain Obtained.	Average.
11	200 grammes	4·6 grammes	2·81 grammes	Amount of strychnine in one entire bird 0·37 milligramme.
11	246 „	5·4 „	3·30 „	Amount of strychnine in entrails of one bird 0·27 milligramme.
16	266 „	6·8 „	4·52 „	Amount of strychnine in one bird minus entrails 0·16 milligramme.
9	190 „	4·4 „	2·42 „	—

The average number of grains found in the bird was eight to nine, but the number varied considerably in the different birds, the minimum being five and the maximum seventeen. One or two grains were found in the digestive tract, but the number rarely exceeded four. In every instance the seed was only partially digested; the majority of the seeds in the crop were entire. The toxic doses according to different authorities are given in Table 2.

TABLE 2.—*Toxic Dose for Man and Different Animals according to Various Authorities.*

	Kaufmann, quoted by Lander. (2).	Relative Sensibility. (Kaufmann-Lander.) (2).	Relative Sensibility. (Blythe.) (1).	Dunn. (2).
	Toxic Dose in Grains.	Milligrammes per Kilo Body Weight.	Milligrammes per Kilo Body Weight.	Toxic Dose in Grains.
Man ...	—	0·4 milligramme	0·7 milligramme (least fatal dose)	—
Horse ...	3·0 –4·5	—	—	—
Ox ...	3·0 –6·0	—	—	—
Pig ...	0·15 –0·75	—	—	—
Dog ...	0·075–0·30	0·75 milligramme		$\frac{1}{8}$th of a grain in 2 minutes. $\frac{1}{8}$th of a grain in 12 minutes.
Rabbit ...	—	0·6 „	—	—
Cat ...	—	0·75 „	—	—
Fowl ...	—	2·00 „	—	—

(Apothecaries Weight.)

1 grain apothecaries ... equals 64·8 milligrammes.
1 kilogramme ... ... „ 2·20 lb. avoirdupois.
1 milligramme ... ... „ 0·0154 grain apothecaries weight.

The official maximum medicinal dose as prescribed for man (daily only) amounts to one-sixteenth of a grain which equals 0.00405 gramme.

Strychnine is absorbed without local effect slowly from the intact skin giving rise to general symptoms. It is rapidly absorbed by way of the mucous surface and on injection. It is easily absorbed from the stomach, the rate being much more rapid from the empty than from the full organ. It is quickly transported by the blood to the central nervous system and organs, but it is not eliminated rapidly; hence it follows that whereas one dose may be without any appreciable effect such doses continuously absorbed or such quantities continuously eaten may eventually have a fatal effect.

The number of birds which may be eaten by man and different domestic animals to supply lethal and toxic doses of strychnine based on the previous figures and the findings we have recorded is shown in the next table.

TABLE 3.

	Approximate Number of Birds which must be Eaten by Man of Weights as under to obtain Fatal Dose according to Kaufmann-Lander.	Approximate Number of Birds which must be Eaten to keep within limits prescribed for Maximum Official Daily Dose.
Weight of man, lb ...	66, 99, 132, 165	—
Entire birds	30 35, 45–52, 60–70, 75–88	11
Birds without entrails	70–80, 105–120, 110–160, 175 200	25

	Approximate Number of Birds which must be Eaten by Dog of Weights as under to obtain Fatal Dose according to Kaufmann-Lander.	Approximate Number of Birds which must be Eaten by Cat of Weights as under to attain Fatal Dose according to Kaufmann-Lander.
Weight of animal, lb.	11, 22, 33, 44	2 3, 7 8, 10, 15
Entire birds	10, 20, 30, 40	2, 7, 9, 13
Birds without entrails	23, 46, 69, 92	5, 16, 21, 30

It will be seen that the number of birds that may safely be eaten by a cat is by no means large, and the number of birds that would be eaten by dogs well nourished is likely to fall short of the number which would be necessary to obtain the fatal dose of strychnine. Dogs are not partial to feathered food in any event. Care should, however, be exercised to remove these birds from the haunts and habitat of household pets in view of the effects of continued dosage referred to above.

It must be pointed out that the limits prescribed for the maximum official dose are to be considered those which should not be exceeded in any case for human consumption, and, further, the variation in the size of the bird and the number of grains eaten all influence the effect on the system. Large birds will naturally con-

sume more, and the birds which were examined were found to be light compared to other finches shot at other times. Nevertheless, it would appear that a little native driver eating about ten cleaned birds a day would be getting the poison only in tonic doses if the mixture were made up as described and the birds eating it were the little "rooi bekkie" finches.

Strychnine is one of the most powerful and rapid poisons that we have. Every precaution should be taken to keep the poison and the poisoned grain properly labelled and in safe inaccessible places. In making up the bait the hands should be kept clean from the paste, and on completion of the operation the utensils should be very thoroughly cleansed and they should be kept for the one purpose only. The removal of the dead birds and the limitation of the amount which may be consumed has been dealt with.

As strychnine is a rapid poison and the chances of recovery are small, both in man and animals, no delay should be made in communicating with a medical man or veterinarian, as the case may be, when poisoning occurs, and every effort made to follow implicitly the advice received.

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Outbreaks of Animal Diseases: June, 1925.

Disease.	Transvaal.	Natal.	Cape.	Orange Free State.	Transkei.	Total for June, 1925.	Total for Calendar Year, 1924.
East Coast Fever	—	5	—	—	1	6	125
Mange	18	—	23	—	10	51	455
Anthrax	17	1	5	4	43	70	1,494
Dourine	—	—	1	—	—	1	14
Glanders	—	—	7	—	—	7	56
Tuberculosis	—	—	—	—	—	—	18
Epizootic Lymphangitis	—	—	1	—	—	1	2

INCUBATION IN SOUTH AFRICA.

By R. BOURLAY,* Acting Chief Poultry Officer, School of Agriculture, Potchefstroom.

Part II.

Selection of an Incubator.—Having decided upon the type of incubator best suited for any particular conditions (valuable advice can generally be obtained from local poultry fanciers and always from the Poultry Instructor at each of the Schools of Agriculture), it is well not to stint or be afraid of a little extra outlay in this direction, for with incubators, the best, even though it may be the most expensive, is the cheapest in the end. There are cheap, shoddy incubators on the market which would appear to be made purely for the sale that they command owing to their low cost, and without guarantee as to their value from the point of view of hatching out eggs. The choice of good machines is by no means restricted, for there are several good incubators on the market, which have proved themselves by results in all parts of South Africa. Though these may appear to be high in price, it is better at the start to get a machine that will give satisfaction rather than buy a cheap article which, in the number of eggs it will ruin, will soon waste more than the extra cost of buying a good machine.

A new incubator is always the most satisfactory. Second-hand machines do in many cases give good results, especially when they have been in good hands, but frequently they are sold because of some defect which often is due to dirt or careless handling. Copies of instructions are supplied with new incubators, and these should be carefully studied and kept for future reference.

Having made the selection, the next thing is to see that the machine is placed properly in the room. If it is one which stands upon legs, place it not nearer than six inches to the wall of the room in order that the air may circulate freely round the machine. This is a very important matter which should not be overlooked. If the machine is of the type which requires a stand or table, set it on the ledge described above, but not less than six inches from the wall. Make sure that it is standing perfectly level, and to ensure this use a spirit level, placing the level first from back to front and then from side to side; if the machine does not stand quite true it cannot be expected to work in a satisfactory manner.

* Having regard to the varying conditions, climatic and otherwise, under which incubation is done in the Union, arrangements were made for the Poultry Officers stationed at the different Agricultural Schools to be associated in the compilation of this article on the subject. Mr. R. Bourlay, Acting Chief Poultry Officer, School of Agriculture, Potchefstroom, also undertook the work of collating the contributions, the other officers contributing being:—

C. C. Rhodes, School of Agriculture, Elsenburg, Mulder's Vlei.
J. J. Jordaan, School of Agriculture, Glen.
T. B. Cross, School of Agriculture, Cedara.
A. Owen John, School of Agriculture, Grootfontein, Middelburg, Cape.

Starting the Incubator.—Remove all the internal movable parts, which, with a new machine, should carefully be dusted and replaced. If, however, the machine be second-hand, clean and disinfect thoroughly all parts with a 1 in 150 solution of any of the standard disinfectants; at the same time wash out the egg chamber with this and allow the whole to dry before replacing the parts. Then place in the egg drawer a small saucer containing one teaspoonful of formalin (full strength), to which may be added a few crystals of permanganate of potash, close the drawer, plug up all ventilation holes, and leave the machine for twenty-four hours. The formalin

Phipps' "Premier" Hot-Air Incubator.

will evaporate and the fumes penetrate into all crevices in the machine and destroy all injurious bacteria. After twenty-four hours, remove the plugs from the ventilation holes and open the drawer for a couple of hours to allow all formalin fumes to escape. With a second-hand machine it is wise to test the capsule or thermostat and also the drawer thermometer to make sure that all are in good order.

The Lamp.—Examine this carefully, especially when the machine is second-hand, to ensure that it is in working order; see that the perforated metal cap under the flame is clean and not

clogged with dirt. If necessary, put in a new wick and see that this is working freely; trim carefully, and fill with a good quality paraffin oil. Inferior grades of oil should on no account be used, as these give a poor flame and are liable to cause the lamp to smoke. See that the heater is quite free from soot and that the mica observation window is clean so that the flame may readily be seen.

The Tank.—The tank should be filled with water. Rain-water is preferable, the temperature of which should be about 120° F. The lamp should then be lit and placed in its bracket, care being taken to see that the small chimney fits closely, especially at the top, in order that there may be a good draught. Do not turn the flame too high, as it will usually rise a little a few minutes after being lit.

When the lamp is lit, the damper which covers the top of the chimney immediately over the lamp should be resting firmly on the top of the chimney, thus forcing all heat from the lamp through the flue which runs through the water tank. The machine may then be left for two or three hours, after which the drawer thermometer should be inspected. If the temperature is not yet up to the required figure, and the damper is still resting on the chimney, the machine may be left for a further period and the drawer thermometer inspected at intervals until the temperature has risen to the required figure, which should be 103° F. It happens occasionally, however, that the damper will rise from the top of the chimney when the drawer temperature only registers possibly 95 degrees, and in such event a certain amount of adjustment is necessary, for the fact of the damper being raised from the chimney means that the heat from the lamp is allowed to escape instead of passing through the tank flue, and therefore no further rise in the temperature in the egg drawer can be expected without some adjustment of the regulator. In order to allow the cap to rest on the chimney again, the egg drawer should first be opened to allow the capsule to contract, then the milled screw directly above the rod which connects it with the capsule should be turned slightly to loosen it and give more play to the connecting rod which rests on the capsule; this will allow the cap to rest on the chimney again, and the heat will once more pass through the tank flue. Should, however, the damper still rest on the chimney when the egg drawer registers 103 degrees after having opened the egg drawer to allow the capsule to contract, it will be necessary to slightly stiffen the milled screw mentioned above. It is very necessary that the capsule should be allowed to contract before any adjustment is made in connexion with the milled screw, for if this is not done there is a risk of the capsule being injured.

If the temperature in the egg drawer only needs altering by two or three degrees, this can usually be done by moving the weight on the damper arm either backwards or forwards as may be required. During the process of incubation, i.e. after the incubator has been set, the milled screw above the capsule should on no account be touched.

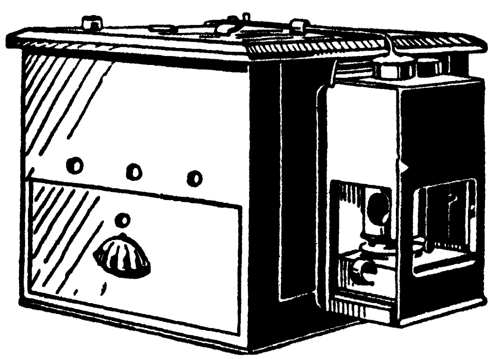
The temperature at which an incubator should be run will depend upon the average temperature of the room, but because there may be—and there usually is—a certain variation in the temperature of the room, this does not mean that the temperature of the

machine must continually be altered. The average temperature of the room should be taken and the machine regulated on the lines indicated below.

Average Room Temperature.	*Drawer Temperature.*
50° F.	105° F.
60° F.	104° F.
70° F.	103° F.
80° F.	102° F.
90° F.	101° F.

Always allow the incubator to run empty for two or three days before placing the eggs in the drawer to ensure that it is working well and keeping an even temperature. A register should be kept and records entered of both the temperature of the room and of the egg drawer at early morning, noon, and night; these frequently prove of great value, besides being of interest.

Before starting the machine again test by the level to make sure that the addition of the water has not thrown it slightly off the level.



"Economic" Incubator.

Selection of the Eggs.—Eggs for artificial incubation should not be more than six days old. This is an important point, for much of the "dead-in-shell" is due to the fact that eggs are stale when set. Eggs of medium size with smooth, well-formed shells give the best results. Thin shelled eggs seldom hatch well because they evaporate more freely than do eggs with sound shells. Further, eggs which have been stored in too warm a room, especially during warm weather, are liable to evaporate freely, and as such seldom give good results. It is wise to test eggs for incubation to ascertain whether there has been too much evaporation. This is done in exactly the same way as when testing for fertility, and the air space can clearly be seen at the large end of the egg. If the air space is too large, or if the white appears to be too thin, allowing the yolk to swing freely, such eggs are unsuitable for incubation and should be discarded. This method has the advantage also of clearly showing defective shells which might have been passed over otherwise.

Uniformity in size is also of great importance. Eggs should never be set that weigh under two ounces each, for if the eggs are

uniform in size, age, and thickness of shell, the general treatment can also be uniform.

When placing the eggs in the drawer or tray they should be marked in a distinctive manner on each side—for instance, " X " on one side and " O " on the other—so that when they are turned it may be done properly, the " X " being placed upwards when the eggs are turned in the morning and the " O " being upwards when they are turned at night.

Place in the drawer all the eggs, which should slope downwards towards the centre, with the small ends pointing slightly downwards. This keeps the embryo at the large end of the eggs, and helps to maintain the correct position until hatching.

Never overcrowd the egg drawer; it is better to have room for ten more eggs than to have one too many.

When the eggs have all been placed in the drawer it may be returned to its place in the incubator and the thermometer put in position. The temperature will now be found to be very low, but this will gradually rectify itself as the eggs absorb the heat and get warmed up. Do not in any circumstances attempt to hasten matters by altering the regulator; leave the machine alone, and in due course the temperature will reach normal.

Early morning is the best time to set eggs, as by evening they will have become warmed up, and the operator will be able to satisfy himself that everything is in good working order before locking up for the night.

Turning and Cooling the Eggs.—It is not necessary to turn or cool the eggs during the first forty-eight hours after the machine has been set, but after that period it should be attended to regularly. Opinions differ as to the number of times eggs should be turned and aired. Some operators have had satisfactory results from turning once daily, whilst others prefer to turn twice daily. If the system of turning once daily is adopted, this should be done at a regular fixed time, say, 10 a.m., when the pressure of the morning's work is over; but if the system of turning twice daily is in vogue, the eggs should be turned early in the morning and late in the evening in order that the periods may be divided as equally as possible. In either method the egg drawer should be removed from the machine and placed upon the table provided for the purpose. With tank machines it is a wise precaution first to remove the thermometer, as this is liable to catch in one's sleeve and get broken if not removed. Carefully turn each egg to the right or left until the hidden mark is on top. At the first turning replace the drawer immediately the eggs are turned, but on future occasions they should be allowed to cool. The period of cooling necessary will vary considerably according to locality, season, and room temperature. In the coastal districts of the Western Cape Province, with a room temperature of 70° F. during the early hatching season, five minutes for the first week, ten minutes for the second week, and fifteen minutes for the third week have been found most satisfactory.

At Grootfontein, Middelburg, Cape, tests have been conducted as to period and number of airings, with the result that turning and cooling twice daily has proved to be most satisfactory, whilst the time allowed for cooling mentioned above has given the best results. However, a certain amount of discretion must be exercised, for

naturally one would not cool for as long periods when the room temperature was very low as one would if it were high.

At Potchefstroom much the same methods as mentioned above are adopted. The eggs are turned and cooled twice daily, the periods of cooling varying according to the room temperature and the length of time that the eggs have been incubating—from five minutes during the first week, ten minutes during the second week, up to fifteen or twenty minutes during the third week.

At the Glen School of Agriculture, Orange Free State, the period of airing found to give satisfactory results is ten minutes during the first week, fifteen minutes for the second week, and twenty minutes during the third week; but as the eggs are aired but once daily it is natural that they should be exposed for a longer period than if this were done twice daily.

During the third week the embryo will stand a great deal of exposure without being seriously affected, especially during warm

Hearson's "Champion" Incubator.

weather. On more than one occasion the egg drawer has accidentally been left out of the incubator for from four to six hours during the third week of incubation: naturally this has been by accident rather than by design. On the first occasion that this happened it was thought that the whole of the eggs would be spoiled, but that particular batch was actually one of the best during that season. Similar experiences have been heard of from other breeders, and in every one the hatching results were not adversely affected.

It is usual to attend to the lamps while the eggs are being aired, but it is most important that the operator should always finish turning the eggs before touching the lamps. The lamps should be filled regularly every day, and the hard crust should be rubbed off the wick with a piece of rag. It is not necessary to cut the wick unless the flame is uneven.

When turning the egg the greatest care should be exercised, as any rough handling or jarring will be liable to injure the embryo, especially during the early stages.

At Potchefstroom it is the custom to dip the hands in a weak solution of some standard disinfectant before handling the eggs, either when testing or turning. This can do no harm, and probably

does much good, for when one is working on all sorts of jobs bacteria must accumulate on the hands and may injuriously affect the eggs. Therefore the wisest policy is to obviate any such risk by dipping the hands in a bowl of disinfectant, which is kept in the incubator room for this purpose.

Moisture.—This is a matter that has caused a great deal of controversy among the poultrymen of South Africa, and will probably so continue, seeing that local conditions vary so greatly and that the amount of moisture in the atmosphere varies so much from week to week. Hence, no fixed time or quantity can be laid down as being suitable to all localities and conditions.

To overcome this difficulty the more advanced breeders resort to the use of the hygrometer as a means of controlling the amount of moisture that may be necessary. There are moisture gauges on the market made especially for use in incubators, and these are of undoubted value and assistance to the operator. The gauge should register 55 to 60 degrees of moisture in the drawer, which is approximately the same as is found under a hen. The operator will also be able to determine fairly well whether there is too much or too little moisture by the size of the air space in the eggs; if this is too small, it indicates that there is an excess of moisture in the machine, whilst, on the other hand, if the air space is too large, it indicates insufficient moisture, which has caused undue evaporation of the contents of the eggs.

With tank machines, which are invariably fitted with moisture trays, it is the usual practice in the mistal area and coast belt to run these machines for the first fourteen days without any water in the moisture tray, but under Karroo conditions and in the high veld, including the Orange Free State and the Transvaal, the moisture tray is filled at the commencement of incubation and kept full during the whole period of the hatch.

During very dry weather it may even be necessary to supplement this by throwing water on the floor of the incubator room or by hanging up in the room blankets saturated in water. The periods when this is most likely to be necessary are during the heavy wind and dust storms frequently experienced in the Transvaal and Orange Free State during August and early September.

Testing.—The eggs are usually tested on the seventh day, though occasionally this is done on the sixth day. The object is to enable the operator to remove all unfertile eggs—which are quite good enough for culinary purposes—and also any eggs which have broken yolks or in which the germs have died. This is best done in a darkened room, it being a simple matter to darken a room for the purpose by making a wooden frame to fit into the inside of the window and cover this with some dark, thick material. A strong light is necessary. When available, electric light is excellent, but otherwise an acetylene bicycle lamp or good oil lamp will serve. The light should be shaded all round or covered with a box, and a hole the size and shape of an egg made just opposite to the flame so that the only light in the room comes through this hole. The eggs are then held close to the hole, and the light shining through them enables the operator to see clearly the condition of the egg. If it is fertile the germ will show clearly, especially in a white-shelled egg, and will very much resemble a spider, the dark centre

being the body and head of the embryo, and the veins, which radiate in every direction, being much like the legs of a spider.

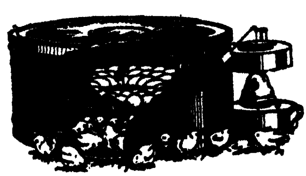
An unfertile egg will be recognized at once, as it is quite clear without any indication of development of the germ.

Addled eggs vary in appearance. In some instances the germ will have stuck to the side of the shell. This is usually indicated by a dark spot adhering to the inside of the shell. A broken yolk will be recognized by the contents of the yolk being mixed up with the albumen or white of the egg, and thus giving a cloudy appearance to the contents. A broken yolk frequently causes a blood-line to adhere to the small membrane inside the egg, and this can be seen clearly, usually being semi-circular in shape.

Testing affords a good opportunity of studying the size of the air space and thus regulating the moisture.

On the fourteenth day the eggs may be tested for the second time, when possibly a few more addled ones may be discovered, and any eggs which appear to be very backward in development should also be removed, and the size of the air space again noted.

The greatest care should be taken in handling the eggs when being tested and the hands should be clean. On testing days it will not be necessary to turn or air the eggs as they will have received sufficient of both during the process.



"Simplicity" Hatcher.

Eighteenth and Nineteenth Days.—The eggs will commence to chip on the twentieth day, and in some instances, when light breeds are being hatched or with very fresh eggs, some will start chipping on the nineteenth day. Therefore the eggs should not be turned after the morning of the nineteenth day; some operators even prefer not to turn after the night of the eighteenth day. But whichever method is adopted, the drawer should not be opened or the eggs disturbed in any way after the last turning until the morning of the twenty-first day, when the drawer may be opened for a short time to admit of the removal of any chicks, and at the same time all empty shells should be taken out, as these will occasionally slip over an egg which is chipped and thus prevent the chick from getting free of its shell. When the first few chicks have been removed from the drawer it will be a wise precaution to move the lead weight forward to the right slightly, as the temperature will be liable to fall somewhat owing to the removal of the chicks, and this will counteract that tendency.

After the chicks are all hatched the machine must be thoroughly cleaned. All movable parts should be well scrubbed with disinfectant, not forgetting the drying box, and when dry everything should be replaced and the machine fumigated with formalin, after which it will be ready for setting again with a fresh batch of eggs.

Best Times for Hatching.—In the Transvaal and Orange Free State the best time for incubation will be found to be from the month of April to the end of September. Chicks which are hatched during the winter months grow out better and are more easily reared than those hatched during the summer months. Further, there is less risk of loss by sudden storms, and the winter-hatched chicks will come into lay at the season when eggs are scarce, and will thus prove to be much more profitable.

In the western districts of the Cape Province the best season for hatching is from June to mid-October; heavy breeds to start from June and to stop about mid-September; light breeds to start about July and stop about mid-October.

A few Difficulties which may be Experienced.—The lift-rod, the lower end of which rests upon the capsule in hot water machines, and the top end of which fits into the hollow of the milled screw at the top of the incubator, will frequently become rusted, and as this is liable to prevent it from working freely, it is often the cause of a jerky temperature. The rust is caused by the condensation of moisture in the machine which settles on this rod and rusts, therefore the rod should be cleaned after each hatch to ensure its even working.

The tank may leak slightly through the cap on the lower or emptying pipe not fitting tightly owing to an excess of lime in the water used in the tanks. If a leak is discernible, the outside of the pipe should be cleaned and a small piece of bicycle tube inserted into the end of the cap; this usually will effectively prevent any further leakage.

A little permanganate of potash kept in the water tray will prevent mould from forming upon the hessian which covers the water tray.

In very dry situations the hessian or canvas covering over the bottom of the egg drawer may be dispensed with, as this will absorb a large amount of moisture which is required for the eggs.

If eggs chip at the small end, it will usually be due to the fact that the small ends have been left pointing upwards after turning.

If a bad smell is noticed on opening the egg drawer it may usually be attributed to the presence of a bad egg; this can generally be located by bending closely over the eggs and smelling them. The presence of a putrifying egg will affect the other eggs, and it must be removed at once.

If the lamp smokes it is usually due to the chimney not fitting well, bad oil, a dirty lamp, or soot or dirt in the flues of the machine.

Delayed hatching is usually due to weak germs or old eggs, the temperature of the machine having fallen or being kept low during the period of incubation, or to the temperature of the machine not being regulated in accordance with that of the room.

Deformed chicks are usually the result of inbreeding, vibration, or careless handling of the machine or the eggs.

Chicks hatching with unabsorbed yolks is frequently due to the temperature of the machine being too high, especially at the end of the hatch.

"Dead-in-shell" may be due to a variety of causes, such as too much or too little moisture; but in many instances it is attributable to lack of stamina in the parent stock; there is little doubt that it is hereditary.

CODLING-MOTH IN APRICOTS.

Preliminary Report on the Biology of the Codling-moth and its Control in Apricots, Wellington, during the 1924-1925 Fruit Season.

By F. W. PETTEY, Ph.D., Entomologist, Elsenburg School of Agriculture.

Part II.

METHODS OF CONTROL.

Thin the Fruit.—Leaving entirely out of consideration the effect of thinning in the control of codling, it is commonly recognized that early thinning before the fruit is half-grown is good orchard practice, because it relieves the trees of the overwork of supporting many small-sized fruits, prevents the breaking of branches from overweight, makes more possible regular annual bearing, and results in the remaining fruit developing larger and consequently being of better quality. It is necessary for the exporter and advisable for the seller of fresh fruit to thin all clusters to one fruit (Figs. 6 and 7). It is questionable whether it would pay the apricot grower who sends his fruit to the jam factory, to thin. At present, unfortunately, quantity and not quality pays the grower who disposes of his fruit to the jam factory.

The main thinning time for apricots occurs in October, too early for many codling infestations to have appeared in the crop. As the earliest larvae begin to leave the fruit about the 10th of November, the grower should concentrate on the picking off and destruction of all wormy fruits from the 1st of November until harvesting begins, and even earlier if there is evidence of infested fruits, in order to avoid the possibility of any worms escaping to winter over and infest the orchard the coming year. Those growers who practise this method of control wait until too late to get the best results. The object of the practice is to prevent the escape of larvae. If the grower waits until harvesting time begins, many worms will already have escaped, and the rush of work will prevent proper supervision. The seeking out and destruction of wormy green fruits should be considered a most important part of orchard practice, and every tree should be inspected for wormy fruits at least once a week.

Some Californian pear growers consider this measure of control to be of such importance that they pay the thinners a halfpenny for every wormy fruit found while thinning.

The wormy fruits should immediately be boiled for ten minutes or placed in vats of water with a little paraffin oil or any used engine-oil on the surface, which is equally serviceable.

Since Kelsey plums are especially susceptible to codling injury and difficult to protect by spraying, two thinnings of this variety

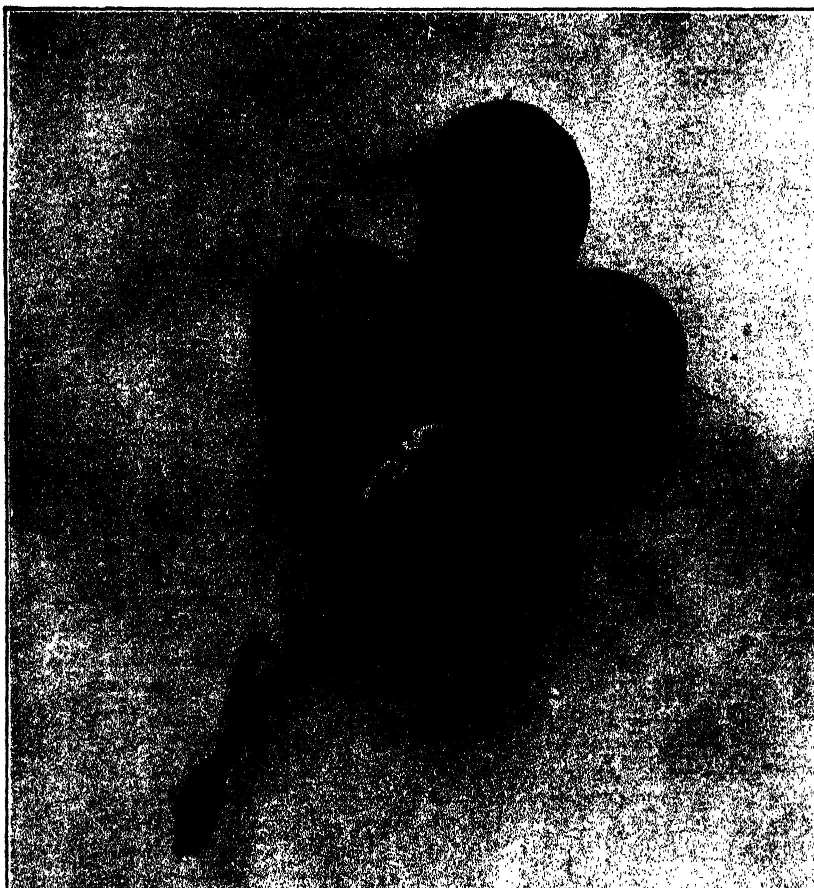


FIG. 6.—Apricots not Thinned. Mottled appearance is due to arsenate of lead.

might be carried out to advantage, a preliminary or principal one in October, or when the fruit is a little smaller than a pigeon egg, and a final one late in November, or when the fruit is about half grown (Figs. 8, 9, and 10). Then every wormy fruit picked off does not mean a dead loss to the fruit-grower who exports. This suggested two-thinning method, however, should first be tested before it is adopted as a regular practice.

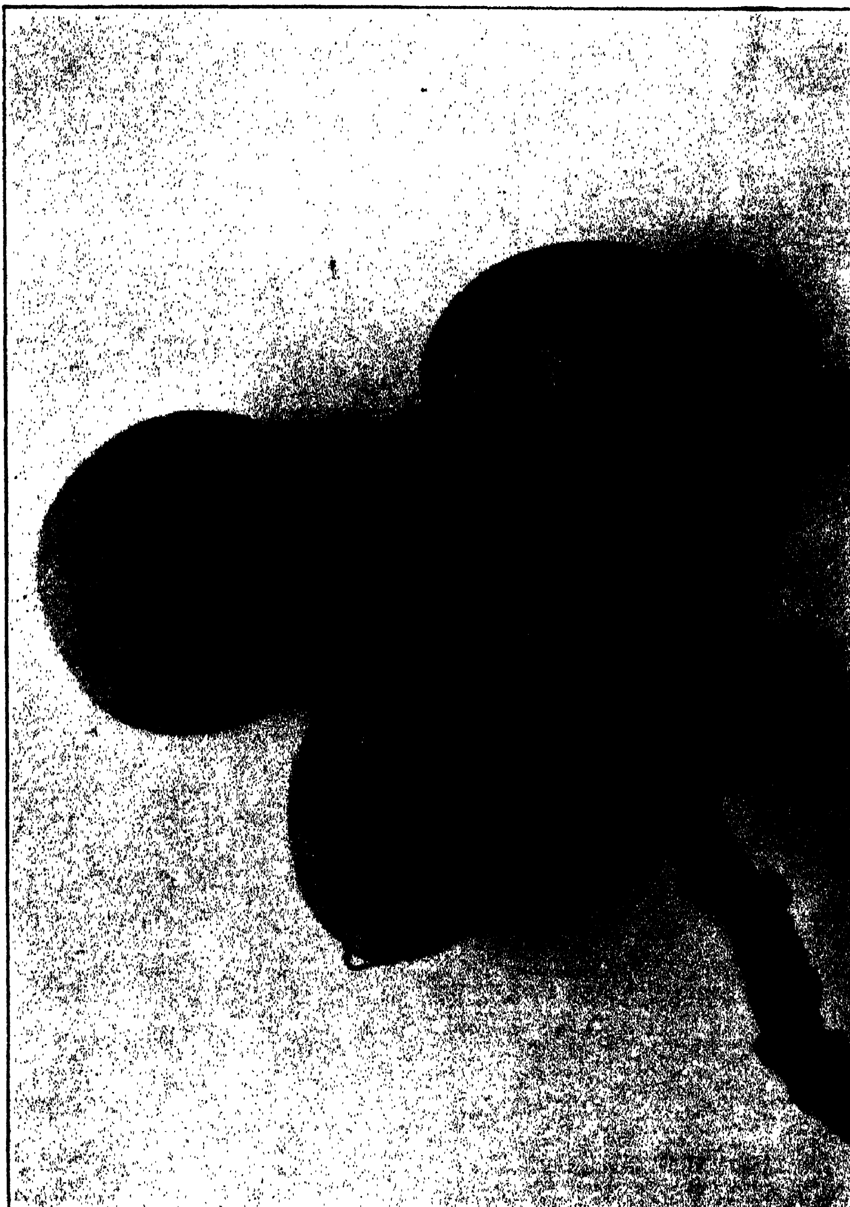


FIG. 7.—Apricots Thinned. Abnormal appearance is due to spraying.

FIG. 8.—Kelsey Plums not Thinned.

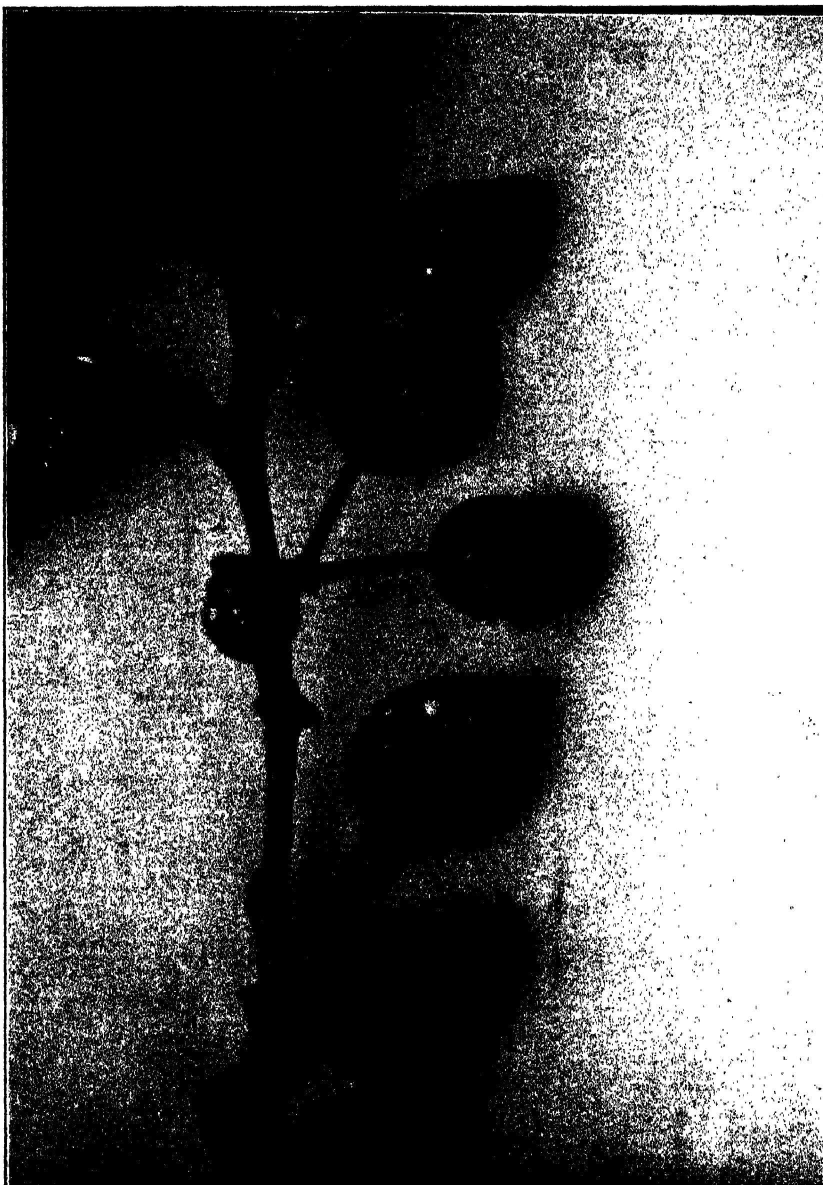


FIG. 9.—Kelsey Plums after first thinning; fruit a little smaller than a pigeon egg. Note that the spray has not spread well.

FIG. 10.—Kelsey Plums after second thinning ; fruit about half-grown.

Pick up Wormy Windfalls.—Wormy stone fruits are more likely to be blown off than sound ones. They often fall to the ground before the larvae leave them. From 130 windfall Wickson plums picked up the 13th of November, 21 fully developed larvae emerged and spun cocoons.

Wormy fruits should be promptly picked up after every wind and properly and immediately disposed of. Failure to do this results in the escape of the larvae, which leave the fruit.

Band the Trees Properly.—Placing a double folded strip of sacking or hessian around the trunk of each tree to catch the worms is common practice in badly infested apple and pear orchards. There it is considered a measure of control supplementary to spraying, but not so important as the latter.

Banding will capture no more than about 30 per cent. of the worms which leave the fruit on the trees. To make the bands 30 per cent. effective the trees must be scraped very thoroughly to remove all loose bark from the trunk and branches and to remove all the natural places of shelter under which the larvae spin their cocoons. The bands act as an attractive place of shelter for the larvae. The degree of attractiveness of the bands depends on the degree of thoroughness of removal of loose bark.

The bark should be scraped after the fruit is harvested or during the winter. Special attention should be given to the scraping of the crotches of large branches at the top of the trunk where the main branches originate. There are frequently dead wood and cracks and holes in stumps on old apricot trees which often make bands less efficient by attracting the larvae if they are not removed or filled up.

A well-sharpened hoe with a short handle, or a knife blade of a mower bolted to a handle, makes a satisfactory scraper.

The importance of seeking for and destroying all wintering larvae found during the scraping cannot be too greatly emphasized.

For bands, strips of grain bags are the most available, economical, and satisfactory. They should be about eight inches wide and a little longer than the circumference of the tree trunk, to overlap a little when placed round the trunk. After the strip is folded lengthwise to make a double band four inches wide, it should be placed tightly around the trunk and held in place by a wire nail two inches long driven, with the head cut off, slanting upwards slightly, into the tree.

The bands should be placed on the trees by the end of October, just before the earliest worms leave the fruit. Beginning about the third week of November, and every twelve or fourteen days afterwards until the fruit is harvested, or up to the end of January for Kelseys, the bands should be examined, and all worms and pupae found under and in the bands or on the trunks of the trees covered by the bands should be killed.

As the earliest larva which appeared in the bands this season developed into a moth on the 5th of December, it is only necessary to collect larvae once from the bands of the early-maturing varieties, i.e. Newcastles, Alphas, and Early Retiefs, providing the harvesting of these varieties is finished no later than the 1st of December, and providing all larvae are collected from the bands of these trees as soon as harvesting is completed. It is necessary, however, to band

the early varieties, because some worms escape from them before the fruit is picked. If bands are not put on to capture these early-developing worms, some of those which escape become moths that increase the infestation in late fruits and others winter over and become spring moths the following season.

After the harvesting season, bands should be removed from the trees and stored until the next spring. If they are left on the trees over winter they serve no useful purpose, and rot. If they are stored they may be of service several seasons.

The writer is convinced that if scraping the bark, seeking for and destroying as many worms as possible during the process, and banding, are thoroughly and carefully done, the fruit-grower will dispose of at least 70 per cent. of the over-wintering worms, which are the cause of the infestation in the next season's crop.

Most growers who practise banding are doing the work haphazardly, are putting bands only on a section of their orchards, and are not even approaching what the writer would consider a thorough scraping away of loose bark during the winter months. Such growers, who have the pest well established in their orchards, will continue to fail to control it satisfactorily.

The Use of a Codling Trap in the Storeroom.—This trap, which has been described fully in the September, 1922, number of this *Journal,* and which is so useful and necessary for the satisfactory control of codling when the fruit-grower has large pear and apple orchards, is not necessary for the apricot fruit-grower who disposes of all fruit brought in the day it is harvested. It has been devised for the purpose of capturing all worms which leave infested fruits collected in piles in the storeroom, and kept until disposed of when they are sufficiently ripe for drying, canning, or even for feeding to pigs.

It has been noted that some apricot growers pick their fruit rather green, and this, including some infested fruits, is left in baskets, boxes, or trays in or near the fruit storeroom until it is ripe enough for cutting and drying. This practice allows worms to escape to nearby sheltered places where they winter and develop to moths which fly to the orchard in spring. All wormy fruit should be sorted from the sound during harvesting or on the day the fruit is picked, and it should then be immediately disposed of to prevent escape of worms. If the fruit-grower has the infested fruit cut up for drying—a bad but frequent practice—he should see to it that the cutters destroy every worm found in the fruit. When a fruit crop is badly infested at the time of harvesting, no more fruit than can be disposed of during the day it is picked should be gathered from the trees, unless there is a codling trap in the storeroom or around a low-walled enclosure where the surplus fruit can be placed. However, there will not be much wormy fruit at the time of harvesting if the measures advised are properly carried out.

Spraying Apricots to Control Codling.—It is well known that spraying apples and pears with acid lead arsenate to protect them from codling-moth infestation is much more important than all other methods combined. It is the principal reliance for the control of this pest in pome-fruit orchards. Although codling-moth infestation of stone fruits has never been sufficiently severe and persistent to

warrant spray measures for its control in other countries, spraying of plums and peaches with lead arsenate is commonly practised in the United States for the control of other fruit-eating pests. Experience there has shown that stone fruits are more susceptible to burning by acid lead arsenate sprays than other fruits. Consequently, either neutral lead arsenate at the rate of 1½ lb. in 40 gallons of water is advised, or 1 lb. of acid lead arsenate in 40 gallons of lime-water, made by slaking 3 lb. of stone lime in water and straining the resulting lime-water into the spray tank. Evidently the degree of burning varies in different localities. Barss and Lovett, in "Better Fruit," February, 1924, state: "Serious burn on stone fruits from acid lead arsenate spray is extremely rare, and even an appreciable burn is uncommon."

Spray tests were made in Mr. Roland Taylor's and Mr. P. J. Malan's orchards in 1924 to determine the efficiency and practicability of several spray mixtures in the control of codling.

Equipment and Materials used in the Spray Tests.—A petrol sprayer of 1½ horse-power, maintaining a pressure of 150 lb., equipped with two spray rods and nozzles, giving a whirling fine spray, was used in the Taylor orchard. In the Malan orchard a large hand-pump, with the same equipment, furnishing an average pressure of 100 lb., was employed.

The sprays were thoroughly applied to all sides of both fruit and foliage.

In the Taylor orchard the plots consisted of four rows of trees running parallel, and those trees selected for records occupied approximately the middle row of each plot. Two unsprayed trees were left as checks near the plots. In the Malan orchard there was the same arrangement of plots, except those including trees sprayed once, which consisted of one row.

The mixtures tested consisted of 1 lb. of acid lead arsenate powder in 40 imperial gallons of water, 1 lb. of acid lead arsenate powder and ¼ lb. of Capex spreader (calcium caseinate plus flour) in 40 gallons of water, and 1 lb. of acid lead arsenate powder plus ¼ lb. of Capex spreader in 40 gallons of lime-water. The lime-water was made by freshly slaking 3 lb. of stone lime in water and then straining the resulting liquid through a piece of hessian into the spray tank.

The Time of Application of Sprays.—The first spray was applied on the 1st to the 3rd of October inclusive in the Taylor orchard, about a week before the earliest eggs began to hatch, and on the 7th of October in the Malan orchard. The apricots sprayed twice received their second application on the 27th of October, about a week before the maximum number of eggs of the first generation were hatching in the orchard.

Conditions Favouring Efficient Control by Spraying.—Observations at the time of application of the first spray showed that a considerable number of fruits still had the dried-up calyx clinging either to the top end of the fruit or around the stem at the bottom end (Fig. 11). In order to remove most of these or to force the poison under them to cover the whole surface of the fruit with poison, it was found necessary to apply a spray of at least 150 lb. pressure.

Spray Results and Conclusions.—Observations and results indicate that sprays will be more efficient if the fruit is so thinned, when it is the size of a pigeon egg, that no two fruits will touch until they are at least four-fifths full grown (Fig. 7). A large percentage of codling which escaped the spray entered the sides of the fruits at a point where two fruits touched. It is impossible to force the spray in between fruits which press against each other.

FIG. 11.—Apricots with clinging calyces. The codling larva often enters the fruit in the shelter of the calyx.

Warning made by the writer at a meeting of Wellington fruitgrowers in the spring of 1924, against spraying, except on a small scale, with lead arsenate until tests could be made to determine the degree of spray burn was fully justified. Records of the spray tests show that two applications of 1 lb. of acid lead arsenate powder in 40 gallons of water, with or without lime or calcium caseinate spreader or both, result in serious burning of both fruit and foliage of Royal apricots (see Figs. 12 and 13). The addition of lime to

either mixture much reduced the burning of fruit, but later in the season the burning of the foliage in the lime plots sprayed twice became very serious. Spraying once with 1 lb. of acid lead arsenate powder in 40 gallons of water, with or without spreader, produced considerable burning of fruit and foliage of Royals, but one application, with lime added to the mixtures, caused little burning and reduced the infestation from 23.6 per cent. in the unsprayed Royals of the Malan orchard and 6.6 per cent. in the Taylor orchard to about 2½ per cent. and about 2 per cent. respectively.

FIG. 12.—Apricot Leaf injured by acid lead arsenate spray.

It appears that Newcastles are less susceptible to burning than Royals. Comparatively little burning of leaves and no burning of fruit resulted in all the plots of this variety, which were sprayed once. The efficiency of one application of 1 lb. acid lead arsenate powder in 40 gallons of lime-water, with or without spreader, in the control of the pest in Newcastles was lessened considerably by cracking of the skin, caused by wet weather (Fig. 10). Nevertheless, the one spraying reduced the infestation from 22 per cent. in the unsprayed trees to 8 per cent. in the sprayed ones.

The writer concludes from the results of the spray experiments that it will pay the fruit-grower to spray once the first week of October his very large apricot trees, or those trees where thorough scraping of bark, banding, and picking off wormy fruits are difficult, with a mixture of 1 lb. of acid lead arsenate powder in 40 gallons of lime-water. The lime-water should be made by slaking 3 lb. of stone lime in a little water, to which are afterwards added a few gallons more water. The resulting material is then strained into

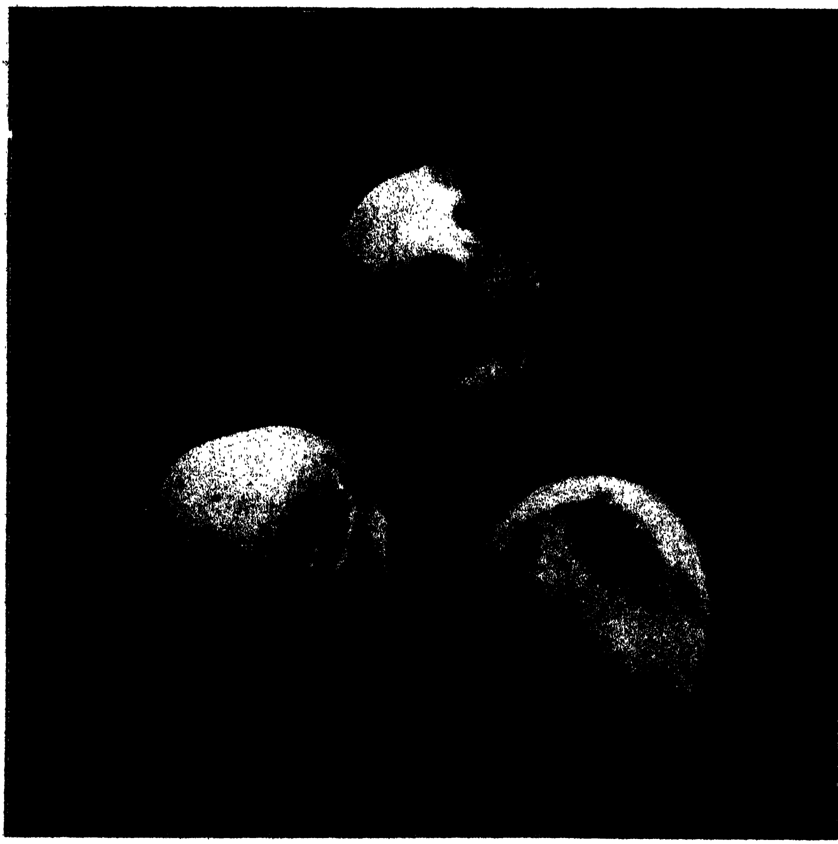


FIG. 13.—Apricot Fruit injured by acid lead arsenate spray.

the spray tank through a fine wire-netting strainer or ordinary, rather thin, clean grain bag.

If the fruit-grower will carry out thoroughly the directions for timely picking of wormy fruits during November, thorough scraping of bark, and killing worms beneath during each winter, and proper banding of his trees, it is quite possible that it will only be necessary to spray the large or old trees where the other control measures will be difficult on account of the height of the branches and the roughness of the bark.

CODLING INFESTATION OF KELSEY PLUMS.

Unsprayed Kelsey plums at Mr. Taylor's farm were 20 per cent. wormy. It was found that 14 per cent. of the worms entered the sides of the fruit; 4.1 per cent. entered the stem end, and the remaining 2 per cent. entered at either the top end or the side groove. This shows that the great majority enter the sides. If the majority were to enter at the stem end, the pest would be controlled without difficulty by spraying, since spray may easily be concentrated in the groove around the stem. It is difficult to protect the sides of the fruit by sprays, because the material does not spread uniformly over the waxy surface of the fruit. Spraying Kelseys twice with lead arsenate powder at the rate of one pound in 40 gallons of water and one-third of a pound of Capex spreader, reduced the infestation from 20 per cent. in the unsprayed to 10.5 per cent. in the sprayed. Eight and four-tenths per cent. of these sprayed trees were wormy at the stem ends.

Unsprayed Kelseys, Taylor's Orchard, 1924-25. *Records of Infestation in Two Trees.*

Total.	Wormy.	Not Wormy.	Stem-Wormy.	Side Wormy.	Top Wormy	Groove Wormy.	Percentage Wormy.	Percentage Side Wormy.	Percentage Stem Wormy.
725	147	578	30	102	8	7	20	14·0	4·1

Records of Two Kelsey Trees, Sprayed Twice with 1 *lb. Lead Arsenate Powder in* 40 *Gallons of Water, with about* ¼ *lb. Capex Spreader.*

Total.	Wormy.	Not Wormy.	Stem Wormy.	Side Wormy.	Top Wormy.	Groove Wormy.	Percentage Wormy.	Percentage Side Wormy.	Percentage Stem Wormy.
652	69	583	7	55	5	2	10·5	8·4	1·0

It is possible that better results from two sprays would have been obtained if they had not been near a neglected orchard of quinces, pears, and stone fruits.

It was found that two applications of 1 lb. of lead arsenate powder in 40 gallons of water caused severe burning and dropping of foliage. The addition of spreader much decreased the burning and dropping of foliage, and the addition of lime water at the same rate as with apricots further decreased the damage.

IMPRESSIONS FROM VISITING FARMS.

Comparatively very few Wellington fruit-growers are giving attention to any measures of codling control whatever. The majority of those who are making some effort to control the pest are doing the work haphazardly or only using half measures. Most of those

who band their trees do not see to it that all loose bark is thoroughly scraped during the winter months and the wintering worms killed. Others are banding only a section of their orchards. Some are using too thin hessian. Most of those who band are inclined to wait until all the fruit is harvested before collections of larvae are made. The few fruit-growers who pick off and destroy the wormy fruits by boiling do not begin the work early enough to get the most efficient results.

The great majority of fruit-growers sent their 1924 crop of wormy apricots to the canning factory, to local markets, or sold them to coolies, or dried them. Only three growers are known to have destroyed any of their wormy fruits.

The disinterestedness in the control of the pest at present, and the tendency to ignore it, is no doubt due to the fact that wormy fruits may be disposed of at payable prices. Payable prices for wormy fruit will be obtained only when the demand for apricots is greater than the supply. It must be admitted that apricots damaged by codling make canned or dried apricots of poorer quality than sound fruit. Coolies and local dealers accept them reluctantly. Canned and dried products made from wormy apricots, as well as infested fresh fruits, tend to lower the market price of the apricot crop. Fruits, dried or canned, of such quality cannot compete long in European markets with first-grade products. Manufacturers and dealers may ultimately find that acceptance of infested fruits is bad business, and they may in the future refuse to receive them. It will, therefore, pay the apricot grower to exert himself sufficiently to produce as few wormy fruits as possible. Failure to do this will result in continued increase in codling infestation and greater loss to fruit-growers.

SUMMARY.

Codling-moth is a serious pest of apricots in many Wellington orchards, where practically no pear, apple, or quince orchards exist, and is gradually spreading through the district. Kelsey and Wickson plums are also badly attacked. Losses from this pest average sometimes 30 to 50 per cent. in apricot orchards where the pest is well established and where no control measures are used.

During 1924 the spring moths began to emerge from over-wintering cocoons in the orchard the 6th of September and continued until the 26th of November. The earliest laid eggs hatched in the orchard the 11th of October, about a month after the Royals had dropped their petals and five weeks after Early Retiefs, Alphas, and Newcastles had dropped all their petals. This indicates that the fruit-grower who contemplates spraying should apply the first spray about the first week of October. The majority of codling eggs hatched in the orchard during the first and second weeks of November.

The majority of codling larvae enter the sides and the groove around the stem of the fruit, unless weather conditions crack the skin before the maximum hatching of eggs occurs, when the majority enter the cracks. Newcastles are very subject to cracking some seasons.

The earliest-hatching larvae remained feeding in the fruit about six weeks, and their whole life-cycle occupied about two and a half months. The earliest eggs of the second generation began to hatch in the orchard about the 12th of December.

Over 65 per cent. of the larvae collected from fruit-tree bands succumbed to heat under the bands. About 90 per cent. of the larvae of the first generation surviving the summer heat wintered over, and only 6 per cent. developed into moths during the same fruit season. Since the great majority of the first generation of larvae hibernated there was only a very small second generation. This indicates that there is practically a one-generation strain of codling-moths in Wellington apricot orchards, and explains why codling-moth is able to maintain itself year after year in apricot orchards.

In orchards containing no large old trees, it is thought possible to control the pest (*a*) by thoroughly scraping off all loose bark of branches, trunk, and crotches of trees and killing all larvae found under such bark during the winter months, (*b*) by banding the trees properly the last of October and collecting the worms regularly every ten to fourteen days from the third week of November until the fruit is picked, (*c*) by regularly picking off every tree the wormy fruits and destroying the larvae by boiling such fruits in water for ten minutes, or by throwing them into vats of water covered with any kind of used engine-oil on the surface, beginning the 1st of November and continuing until the harvesting begins. Wormy fruits, picked off during harvesting should either be treated promptly in the same manner, or, if the grower insists on the bad practice of using them commercially, they should be cut up for drying or disposed of to coolies, etc., on the same day they are picked. They should on no account be left overnight in boxes, trays, or piles in or near fruit storerooms or in the drying-grounds, because the worms would then escape from them.

Spraying thoroughly once during the first week of October with 1 lb. acid lead arsenate powder in 40 gallons of lime-water, with or without spreader, reduced codling infestation from 23.6 per cent. in unsprayed Royals of the Malan orchard and 6.6 per cent. in the Taylor orchard to about 2½ per cent. and 2 per cent. respectively, without causing burning of importance. Spraying *once* these mixtures, using 40 gallons of water in place of lime-water, and spraying *twice* with or without lime-water, and with or without spreader in the mixtures, resulted in better control, but caused very serious burning of fruit and foliage.

Newcastles were less susceptible to burning than Royals. The efficiency of one spray of 1 lb. of acid lead arsenate powder in 40 gallons of lime-water, with or without spreader, in the control of the pest in Newcastles was lessened considerably by cracking of skin caused by wet weather. Nevertheless, one application reduced the infestation from 22 per cent. in the unsprayed trees to 8 per cent. in the sprayed ones.

The spraying data collected indicate that in badly infested orchards large trees, or trees so old that it is impracticable to remove natural places of shelter by scraping off loose bark, should be sprayed very thoroughly once the first or second week of October or just before the codling eggs begin to hatch in the orchard, using a

mixture of 1 lb. of acid lead arsenate powder in 40 gallons of lime-water, made by slaking 3 lb. of stone lime in a little water and then pouring into the spray tank through a mosquito wire-netting strainer, a piece of hessian, or a rather coarse mesh clean grain bag. Such trees should be very thoroughly sprayed, using a large hand-pump, or preferably a petrol pump, with a pressure of no less than 150, and nozzles giving a fine whirling spray. The spraying should be supplemented as much as possible with the other control measures mentioned.

Fruit-growers in whose orchards the codling-moth is not yet well established should give particular attention to the control of the pest, to prevent it from increasing in infestation.

FURTHER INVESTIGATION NECESSARY.

The foregoing account of the codling-moth, and the data obtained, are based on studies covering one season, carried out under difficulties because the orchards could be visited only once or twice a week. Further investigation may show that the seasonal history of the pest varies somewhat in different seasons. Certain details of importance have not yet been studied. A neutral lead arsenate is being imported from California and will be tested during the coming season.

ACKNOWLEDGMENTS.

The writer desires to acknowledge the valuable assistance given by the following Wellington fruit-growers, without which it would have been impossible to do the work: Mr. Roland Taylor and Mr. P. J. Malan, at considerable financial sacrifice for the benefit of the district, lent sections of their orchards for spraying tests. Mr. Keith Taylor very kindly kept daily records of spring-moth emergence, collections of larvae from bands, and assisted in other respects. Mr. Charles Cillie made observations of the hibernation of larvae in bands possible, and Mr. Frans Malan generously lent his petrol pump for spraying work.

[NOTE.—This article is being published also as a bulletin, which will include several tables recording valuable data.—EDITOR.]

COTTON-BREEDING IN THE LOW VELD.

By F. R. PARNELL, Barberton, with covering memorandum (to the Secretary for Agriculture) by Mr. S. MILLIGAN, Pretoria, representatives of the Empire Cotton Growing Corporation collaborating with the Union Department of Agriculture.

I.—MR. MILLIGAN'S MEMORANDUM.

IN my proposals for the staff employed by the Empire Cotton Growing Corporation, submitted to Government in August, 1924, I suggested the recruitment of two entomologists to be employed in the Division of Entomology; one chemist to be similarly placed in the Chemical Division; and that to Mr. F. R. Parnell, who had already been recruited by the Corporation to work directly under me, should be allotted the duties of cotton-breeding for the low veld area. It was felt that the problems to be faced in breeding cotton for the low and middle veld areas presented a distinct cleavage owing to the existence of the Jassid problem in the former and the necessity of breeding for early maturity in the latter. Reports of the work carried out by the Corporation officers in the Entomological and Chemistry Divisions will be presented in due course by their respective heads. I have asked Mr. Parnell to write a short note on his work and observations up to date, with special reference to Jassid attacks in view of the anxiety of cotton-growers on the low veld regarding this pest. I also wish to keep the Empire Cotton Growing Corporation fully informed of the progress made in breeding Jassid-resisting plants, as it is of importance in other parts of Africa.

Although Mr. Parnell's records are not yet complete, he has been able to summarize them up to the 11th of April, 1925. A publication of the note would, I feel sure, go a long way towards reassuring public opinion that the ravages of the Jassid can be largely countered by plant selection and breeding.

The main feature of the note is the clear demonstration, through growing the progeny of single plants side by side, of the inheritance of Jassid-resisting qualities, and the consequent possibilities of breeding resistant types. Further, the Cambodia selection from India* has been entirely Jassid-proof, while other types varied from " high resistance " to Jassid in the case of Z.1 (a new type found in a large number of single plants selected at random in Zululand last year) to " no resistance at all " in the case of Watt's Long Staple. The Cambodia type, however, requires acclimatization, as in this its first year in South Africa, it tended to " run wild " and could not be

* See article " Jassid-resistant Cotton," June, 1925, issue of this *Journal*.—EDITOR.

multiplied for immediate distribution on account of its habit. It is fortunate, however, that the type Z.1 shows, in addition to high Jassid-resistance, other excellent qualities, and it is proposed to further propagate the seed of this variety. It will, of course, be tested next year to check this year's results; also some of the seed has been self-fertilized for the sake of further improvement; but, in view of the urgency of producing "Jassid-resisting" seed in large quantities at the earliest moment, the remaining seed will be multiplied in the most economical manner possible. If, therefore, the strain turns out all right in next year's trials, no time will have been lost, and it will be possible to plant a few hundred acres of it in 1926. Given good seasons, the year 1927 should see large quantities of Z.1 available for distribution. Meanwhile, if all goes well, other and possibly better strains will be forthcoming, and there should be little difficulty in fitting these into the various low veld cotton-growing areas. Mr. Parnell gives reasons for abandoning mass selection as a rapid means of giving some temporary relief; but, at any rate, even mass selection would not have given us any bulk of seed before 1927, and the produce from Z.1 will, of course, be infinitely superior to anything we could have obtained by that means.

It will be seen that Mr. Parnell is of opinion that damage by Jassid is due, partly at least, to a toxic effect caused by the insect, and that resistance consists not only in some degree of immunity from attack, but is also due to a constitutional power of tolerating the action of the pest. He further states that "resistant plants give the impression of being specially tough and hardy and capable of withstanding all vicissitudes better than the average plant." If these observations are confirmed, they are obviously of the greatest importance. It will also be observed that altough Z.1 was found in a field of Zululand Hybrid, resistant plants have been found in other varieties, thus widening, to a very considerable extent, the choice of selection. Mr. Parnell has already about 150 plants, selected mainly from Bancroft and Zululand Hybrid, all showing Jassid-resistance and with lint about 1¼ inch, and this year's experience indicates that a considerable number of these will be found to breed true to Jassid-resistance.

Whether, in view of the promising nature of this year's results, it will be necessary to continue purely entomological work on Jassid, is for decision by the Division of Entomology. In the most favourable circumstances, two years at least will elapse before pure seed of a Jassid-resistant strain can be issued in large quantities, and it may thus be worth while to continue work on dusting and spraying as a specific against attack. Meanwhile, however, the boll-worm problem presses for some solution to mitigate at any rate the earlier attacks in the middle veld area, where early infestations make the crop mature later. The low veld area will suffer less through early boll-worm attacks if the Jassid can be overcome, as the main damage in this case is due to the combination of the two pests.

II.—MR. PARNELL'S REPORT ON COTTON-BREEDING IN THE LOW VELD.

The desirability of improving the varieties of cotton grown in the Union has been increasingly obvious to all concerned in the industry for several years, and it was partly for work in this direction that

the help of the Empire Cotton Growing Corporation was solicited. Mr. Milligan, after his arrival in June, 1924, discussed the situation with officers of the Tobacco and Cotton Division, and it was decided that the breeding work already in progress at Rustenburg should be applied especially to the middle veld areas, and that the Corporation plant breeder should work for the low veld cotton-belt, which extends through the eastern Transvaal into Zululand. It is with the latter area that this note is concerned.

Work was started at Barberton at the beginning of the 1924-25 season on a piece of land set apart by the Prison authorities and on special plots very kindly grown by Messrs. Andrews and Spear on their own farms. The crop grown comprised the following:—

(1) A collection of the chief varieties under cultivation in the Union.

(2) Several varieties imported from the United States of America and one from India.

(3) Several strains of Improved Bancroft and Meade raised by officers of the Tobacco and Cotton Division.

(4) About fifty single plant selections out of Zululand Hybrid from Messrs. A. P. Rouillard and Goss Estates, Ltd.

Thanks are due to a number of gentlemen who supplied the seed and helped to make the whole collection a good one.

The season is not yet finished and quantitative results have not been obtained, but certain definite conclusions may be drawn from the experience gained up to date.

It was originally intended to work mainly on single plant selections, but also, if possible, to make mass selections in the two varieties most largely grown in the Union, viz., Zululand Hybrid and Improved Bancroft, in order to secure some immediate improvement. With both varieties, however, though the seed planted was the best obtainable, an examination of the crop at the beginning of the flowering period showed enormous variation, no dominant type existing, but good, bad, and indifferent plants being hopelessly mixed. The good plants covered a wide range of types, of which many appeared capable of giving sound economic strains if separated out and purified. In such a case it is impossible to determine the best type simply by inspection, since there is no such thing as an " ideal type " recognizable as such on sight. Mass selection of a number of separate types would have given very little bulk of seed of each, and the sole advantage of such selection would have been lacking. It was decided, therefore, to concentrate entirely on single plant selections. The appearance of Jassid later in the season settled this point still more definitely. The whole breeding work is so bound up with this pest that a detailed consideration is necessary.

Jassid (*Chlorita fascialis*), often referred to as a leafhopper, is a very small winged bug which breeds on the underside of the leaf and sucks the sap. The effect produced on the leaf appears to be due more to some poisoning action than to a simple depletion of sap, but nothing definite is known on this point. In a bad attack the older leaves turn red and fall off; younger leaves curl up, turn

reddish-brown, and gradually shrivel and dry up: the whole plant dries up considerably, but the growing points may remain alive and capable of shooting again if the Jassid disappears.

As the plant matures it becomes increasingly susceptible to Jassid attack. Speaking quite generally, the damage does not become serious until many of the earliest bolls are practically mature. If the early setting is good, a fair crop may thus be obtained in spite of Jassid, though, of course, the loss it causes is still serious. Where, however, as is often the case, boll-worms have depleted the early crop of bolls and Jassid prevents further setting, the position is most serious.

Jassid attacks have occurred over practically the whole of the low veld cotton-belt, of which no part can be considered free. The intensity of the attack appears to depend largely on the season, more damage being caused in wet seasons. At the best, the pest is a serious one which must be overcome if the cotton-growing industry is to be a success in the low veld.

It has been known for many years by workers in various countries that susceptibility to Jassid and similar leafhoppers varies largely with the variety and depends to a great extent on the degree of hairiness of the leaf. Resistant types have been raised in India, and one of these, a selection from Cambodia, was sent by the Cotton Specialist, Madras, to Mr. Worrall, Tobacco and Cotton Expert, Barberton, who has written an article on the subject.*

The effect of Jassid on the different varieties and strains grown has been carefully noted throughout the season. Of the Union varieties, Watt's Long Staple is uniformly very susceptible. All the others are very mixed and show great variation from plant to plant, though the proportions of plants showing any given degrees of susceptibility varies a great deal with the variety. Of the imported varieties, Cambodia, already mentioned, *shows complete immunity;* the Jassid appears not to breed on it or damage it in the slightest. The United States of America varieties were all rather susceptible, and Webber 49 is the only one which offers any hope of possible improvement by selection. A number of strains of Improved Bancroft from the Rustenburg Experiment Station and two strains of Meade raised by Mr. Worrall were all too susceptible to be of any value, though one of the Meades might be useful for further selection.

The single plant selections from Zululand Hybrid proved extremely interesting. Some lots were more or less mixed, whereas others, especially such as were uniform in habit and general appearance, showed considerable uniformity as regards susceptibility to Jassid. Of the uniform lots, many were distinctly susceptible, whereas others showed definite resistance of various degrees. The best lot, Z.1 of the table below, was uniformly good; all plants remained green throughout the attack and are now, early May, still healthy. In many of the worst lots every plant was brown by the end of March. There could be no better demonstration of the *inheritability of Jassid-resistance* and of the corresponding possibility of breeding resistant strains from the present mixed varieties.

The table given below shows an analysis of a number of varieties growing side by side. Every plant was roughly classified according

* June, 1925, issue of this *Journal.*

to the degree of damage by Jassid on 11th April. The figures show the percentage of plants of the different degrees:—

Degree of Attack.

Variety.	Nil.	Slight.	Modera'e.	Rather Bad.	Bad.
Cambodia	100	—	—	—	—
Z.1	4	60	36	—	—
Uganda	3	8	27	32	30
Improved Bancroft	—	3	12	38	47
Zululand Hybrid ...	—	2	14	38	46
Griffin	—	—	2	27	71
Watt's Long Staple	—	—	—	—	100

The strain of Cambodia imported is very markedly resistant, the boll is large, and the lint of many of the plants is over 1⅛ inch in staple. Its habits, however, as it has grown this season, makes it of doubtful value as a field crop. It is very large, some of the plants being 8 to 9 feet high and almost as much in diameter, and the stems are rather weak and delicate, making it subject to serious damage by wind. It may settle down to a more reasonable habit after a few seasons in this country. It is hoped to obtain other less rampant strains from India for trial next season.

The best single plant selection out of Zululand Hybrid, Z.1 of the above table, is suitable for immediate multiplication. It is markedly uniform, strong-growing, rather lax and upright in habit, big bolled, well over 1⅛ inch in staple, and definitely resistant to Jassid. The number of bolls is only fair for the size of plant, but the yield per plant will be uniformly good. A number of plants of this strain, many of which are selfed, has been selected for planting separately next season to purify and improve the strain still further if possible. The bulk seed should plant about 5 acres next season, and thus give enough seed to put out for multiplication if the strain proves good enough.

Single plant selections have been made from fields of Improved Bancroft and Zululand Hybrid specially grown for this purpose. Fortunately both fields were attacked by Jassid, and it was thus possible to pick out resistant plants which showed up strikingly green amongst the general reddish-brown mass. It is practically certain, in view of the behaviour of the Zululand Hybrid selections this year, that many of these plants will give rise to markedly Jassid-resistant strains. About 150 plants have been selected so far, all of good types carrying a large crop of bolls, and nearly all with lint of about 1¼-inch staple. On the whole the Bancroft selections appear to be most promising, as they are generally of a better habit and carry a larger boll than those from Zululand Hybrid. A few selections from other varieties have also been made.

It may be noted that all the resistant plants are distinctly hairy, though all hairy plants are not necessarily highly resistant. The resistance appears to be due partly to some degree of immunity from attack and partly to a constitutional power of tolerating the action of the pest. In fact, the resistant plants give the impression of being specially tough and hardy and capable of withstanding all vicissitudes better than the average plant.

It will be seen that there is every reason for hoping that the Jassid problem will be solved satisfactorily in the very near future, thus removing one of the most serious obstacles to the successful development of cotton-growing in the low veld areas.

This note cannot be closed without some reference to the very willing support and assistance given by the cotton-growers of the district. Through the good offices of the De Kaap Agricultural Society, the Barberton Municipality has offered to the Department of Agriculture, practically free of rent, 100 acres of land for experimental and plant-breeding purposes. It is hoped that a proper cotton-breeding station will be opened on this land for next season. A sufficient area for next season's crop has already been cleared and ploughed free of charge by the society in order that the broken land should receive the late rains and thereby become more fit for experimental work. The land is in a solid block, very level, and possessing a deep, uniform, good soil thoroughly suitable for experimental work. The situation of the De Kaap Valley midway down the cotton-belt, its easy accessibility by rail, the existence of a well-controlled ginnery and good organization for seed supply and distribution, the constant presence of Jassid for testing strains, and the existence of large stores from which sudden urgent requirements of the work may be obtained, are all factors which make Barberton a very happy choice for the new station.

An experiment was started in which the same sets of varieties were planted side by side at Barberton, Malelane, and Candover. From the results so far seen, it would appear that a variety good in one of these areas would also do well in the others. If this holds good, as a general rule, it will greatly simplify the work of producing strains suitable for the various parts of the low veld area.

Low Temperature Research *re* Fruit Export: A Valuable Gift.

The Secretary for Agriculture has accepted, on behalf of the Department, a J. & E. Hall CO_2 Compressor, complete with certain accessories, as a personal gift from Mr. F. Claude Sturrock, of Johannesburg. Mr. Sturrock's object in presenting this valuable piece of machinery to the Department is to encourage low temperature research in South Africa, such as Mr. Griffiths, of the Division of Botany, has initiated at the Low Temperature Research Station at Capetown. Fruit-growers ought to be greatly indebted to Mr. Sturrock for his public spiritedness, as his gift will materially aid the investigations in fruit. It is to be hoped that Mr. Sturrock's action will form a precedent, which others might well follow. (*Division of Botany.*)

THE ORGANIZATION OF A GREAT INDUSTRY.

The Success of the California Fruit-growers' Exchange.

By H. CLARK POWELL, Professor of Horticulture, Transvaal University College.

SOUTH AFRICA is to-day an open forum for the discussion of many problems upon the proper solution of which is based the future advancement of the country. Questions such as the permanence of the white portion of the population, the longevity of the gold industry, the establishment of a large cotton industry, the poor white problem, and various others are receiving much attention. To the citrus growers, and there are many in the country, no problem is so vital as the building up on sound lines of an extensive citrus industry.

The success of any agricultural enterprise depends roughly on two broad factors—the producing of high-grade crops and the sale of such products at a price sufficiently high to pay a suitable return to the grower consistent to his investment of capital and labour. The recent visit to this country of Dr. H. J. Webber, Director of the Citrus Experiment Station, Riverside, California, has meant much to the citrus growers. Dr. Webber's sound advice on cultural matters will result in the production of more and better crops of citrus fruits, as some questions which had been unanswered before have been clearly and satisfactorily explained. A full report on his observations and recommendations will be issued in the near future, so the writer of this article will limit himself solely to the marketing problem, which, after all, is of just as great importance as production.

FIVE YEARS HENCE.

The export of citrus fruits for 1924 amounted roughly to 500,000 cases; by 1930 the amount for export should be at least 7,000,000 cases. Obviously, a serious problem is before the growers of this fruit, and upon their solution of the question rests the future of the industry. Several million pounds sterling are invested in groves and accessory equipment, and it behoves those interested to safeguard their investments by taking such steps as will ensure the successful marketing of the large crops to be produced. The writer has frequently heard the statement that South Africa will not be able to market the large citrus crops of the next few years; a great many persons have expressed themselves as being uncertain, and, in general, the view taken is "we must wait and see." Such a course if

followed out will certainly lead to failure, and it is only through a careful study of the problem that success will come.

LEARNING FROM FIFTY YEARS' EXPERIENCE.

When one is in difficulties, the natural tendency is to look for aid from some one who has safely met the same conditions. The same thing is true of countries, and many fruit-growers here have shown a keen interest in the advancement of California.

A careful study of the situation as it exists to-day in California will be of great value in solving the citrus-marketing problem of South Africa, because the fundamental principles underlying agricultural organization are the same the world over. A consideration of the citrus industry of California calls pre-eminently for a discussion of the California Fruit-growers' Exchange, without which the industry could not exist.

Commercial planting of citrus fruits in California dates from 1876, when the first transcontinental railroad reached Los Angeles, thereby forming a direct means of rapid communication between the Atlantic and Pacific coasts, a distance of 3,000 miles. Previous to that time no market had been available, and only sufficient oranges and lemons were grown to supply the very limited local demand. The few small plantings proved, however, that the climate and soils of the region were admirably suited to the culture of citrus fruits. Navel oranges were introduced in 1873, and when the two original trees came into bearing the marked superiority of the fruit over the seedling types was very obvious. The success of this new variety, and the completion of rail communication with the east, led to extensive planting of oranges.

A WORLD EXAMPLE.

The citrus industry of California is universally acknowledged to be the most soundly organized agricultural enterprise in the world. In order to understand clearly the position to which the industry has risen, it is necessary to know something of conditions in the early days. By 1887, shipments had reached about 900,000 cases, which were sold directly through commission men or to crop buyers at the point of production. The numerous dealers handling oranges acted independently of one another, and when a car was billed to a certain market there was no surety that ten or a dozen other cars would not arrive on the same market the same day. Such a condition, of course, led to enormous price fluctuation, and with the rapidly increasing crops the buying of oranges at the point of production became outright speculation. Freight and packing charges were high, and, in view of the fluctuations in price from day to day and from market to market, no buyer could afford to pay much for a crop of oranges, regardless of quality, and, as a matter of fact, many cases occurred when no offers were made at all. Growers are convinced that an agreement was made among the buyers whereby a certain section of the citrus region was allotted to each buyer. Hence a grower might receive an offer from one buyer, and because of the division of territory would have no other chance to sell. Although market prices fluctuated greatly, the general offers of the buyers were remarkably uniform—and low.

SEARCHING FOR THE BEST METHOD.

Sale by commission was just as unsatisfactory. A grower would sell through a commission agent who would consider market conditions and bill the fruit to the most likely market. The journey was long and rough, handling conditions in harvesting and packing were poor, and much mechanical injury and subsequent decay resulted; the system of refrigeration was not yet perfected, other fruit might arrive on the same market at the same time, and, consequently, the risk of getting a poor price was exceedingly great. Because of the frequency of heavy losses through decay, a commission merchant could report a shipment as having arrived in poor condition and make a poor return to the grower, whereas in reality the shipment might have been sound and sold for a handsome price. (This condition is doubtless familiar to numerous growers in this country.) Detection of fraud or deceit is difficult when the parties concerned are several thousand miles apart. Transportation conditions were far from satisfactory, and much loss resulted from improper temperatures, poor ventilation, and rough handling en route. An individual grower had no check on the railroad company if the latter agency stated that conditions in transit were as they should be. (This is another state of affairs that is not unknown to South African growers.)

Several years of " red ink " sales followed, and conditions were such that the future success of the industry was very doubtful. The majority of the growers sold their crops for less than the cost of production, and in 1892-93 many actually sold their crops for less than the packing and shipping charges, hence they not only produced a crop of fruit for nothing but were actually called upon to pay freight and packing charges greater than the value of the crop on the market. Such a condition was tersely described as being a " red ink " sale.

Various attempts were made to co-ordinate the interests of growers and shippers; regulation of shipments and price control were tried but failed completely. In 1893, a representative meeting of citrus-growers was held in Los Angeles, and a plan for co-operative organization was presented and accepted by the meeting. Work of organization went rapidly forward, and in October, 1895, the Southern California Fruit Exchange was formed.

A FATEFUL YEAR.

The new organization went steadily ahead in power and scope of activities; in 1895, 32 per cent. of the crop was shipped through the association, and by 1903 the amount handled was 45 per cent. At this time a step was made which very nearly led to the downfall of the entire Exchange. The Southern California Fruit Exchange combined with the leading independent shippers to form the California Fruit Agency, and efforts were made to sell the crop at the points of production. During the millenium it is said that the lion and the lamb shall be close friends; with human nature as it is to-day, any effort to combine into one organization parties with such widely diverging aims as producers and speculative dealers is bound to fail. Such proved to be the case in the mesalliance termed the California Fruit Agency; internal dissension and failure to accomplish desired

ends led to the recontinuation of an independent course by the Exchange in 1904.

ORGANIZATION TRIUMPHANT.

In 1905, due to the extension of citrus growing to different sections of the State, the present name of the organization, the California Fruit-growers' Exchange, was adopted.

We have seen the reasons for the organization of the citrus-growers; now let us turn to the actual structure of the marketing agency which has been built up. Briefly, the conditions causing failure of the industry on an unorganized basis can be summed up by the statement that the existing marketing methods completely failed under the pressure of a rapidly increasing crop. Thus the growers were compelled by economic force to take one of two courses, to organize co-operatively or to go out of business.

The California Fruit-growers' Exchange is composed of three units, built up from the 12,500 citrus producers who comprise the grower-membership. The growers formed local associations, of which there are now about 210; these in turn federated to form 22 district exchanges, and the latter formed the main body, the California Fruit-growers' Exchange.

LOCAL ASSOCIATIONS.

The functions of the local associations are to pick, grade, pack, and, in general, prepare for shipment the fruit of the members. Work of this nature calls for a considerable investment in equipment, as each association must own and operate a fully-equipped packing-house. This calls for ownership of a site, a house, elaborate machinery, picking-boxes, bags, clippers, and ladders, motor-trucks, and all the other essentials for picking, hauling, and packing large quantities of fruit. The money invested by a local association runs from £4,000 to £50,000, depending on the acreage held by its members.

The money necessary for the erection of a packing-house and the purchasing of equipment is raised by the members of the local association. No financial aid is rendered by the central body. In a given locality, we will imagine that one hundred citrus-growers, owning 1,000 acres of oranges, desire to form a local association for the purpose of preparing their fruit for shipment; the money necessary we will suppose to be £25,000. There are two general methods by which the undertaking can be financed—by the formation of a capital-stock association or by the formation of a non-stock association, both forms having certain advantages.

PROVIDING FUNDS.

If a capital-stock association is desired, stock will be issued to the members. Each member purchases stock according to the number of acres held, number of trees, or according to the estimated number of boxes to be shipped. If an acreage basis is decided upon, in the case in question the assessment will be £25 per acre. Each member

then subscribes to the stock at the rate of £25 per acre, payable immediately or according to arrangement with the directors. The next step is for the embryo association to acquire money for the construction and equipment of a packing-house. Of course, all purchasers of stock will not be able to pay cash for their stock, but as the growers are legally bound to pay eventually, local banks will advance money, holding the notes of the growers (which were given to the association in lieu of full payment for stock), as security. Grower control of the association is kept intact by the provision that only bona fide growers can purchase stock; in the case a grower disposes of his property, his stock is either sold to the association or to the new owner of the property. Dividends are not paid on stock, as the associations are all on a non-profit basis. Payment for stock is usually made by authorizing the association to withhold a specified amount (usually 3d. to 6d.) per box of fruit shipped.

The financing of a non-stock association can be done in several ways. Members can lend money to the directors or give them notes which can then be used as collateral for borrowing from a local bank. Grower-members can give notes to the association at a certain rate per acre, per tree, or per box to be shipped. Briefly, non-stock association financing is accomplished through the creation of borrowing power for the directors. This is done by the members guaranteeing that all amounts shall be repaid. Banks or individuals lending money take a first mortgage on the property and equipment purchased with the borrowed money. Repayment of loans is made through a per box assessment, usually amounting to 3d. to 6d. per box. Still another method, and one usually adopted in conjunction with the above, is the provision for a membership fee.

During the first few years of its existence, a capital-stock association has more borrowing power than one without capital stock, but when the success of the latter has been proved there is usually little difference.

Local associations are run by a board of directors who are elected from the member-growers. These directors hire a capable manager (salaries range from £700 to £1,700 per year), who in turn hires the men and women necessary for the operation of the packing plant. These include a house foreman, field foreman, graders, packers, pickers, etc.

LINES OF CONDUCT.

The following brief notes from the contract and by-laws of a typical association clearly illustrate the objects of organization and the methods of operation:—

" It shall be the duty of all members . . . to sell and market their citrus fruit through the agency . . . of this corporation only, and no member shall be at liberty to sell, market, or consign his citrus fruits through any other agency than such as are directed . . . by this corporation."

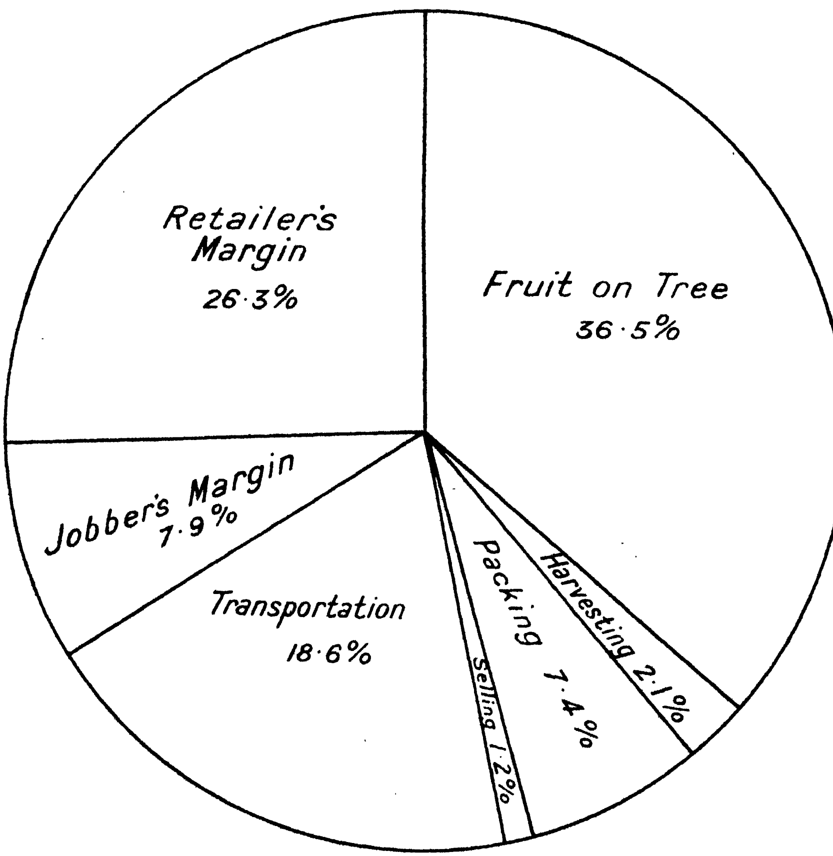
" In case any member . . . does otherwise sell . . . his said citrus fruits, his voting power and interest in this association is forfeited, and he shall pay to the treasurer the sum of twenty-five cents for each box so sold . . ."

"Each member selling fruit through this corporation shall pay such brokerage as may be found necessary to defray all expenses necessarily incurred . . ."

"It shall be the duty of all members to see that their fruit is picked and handled in as careful a manner as possible, and all fruit shall be delivered to the packing-house on conveyances with easy

Distribution of Consumer's Dollar Paid for Oranges,
1st November, 1918, to 15th November, 1923.

[*Powell.*



springs. Any fruit handled in a careless manner shall be subject to rejection."

"Any member may withdraw his citrus fruit for any year by filing a notice with the secretary during the first fourteen days of September of any year."

"Each variety of fruit shall be graded according to quality . . ."

"The board of directors shall have authority to determine into what pools deliveries of fruit shall be divided . . ."

The association in its contract with members agrees to pick, pack, and market all fruit grown by its members, the association determining the place, time, and price at which the fruit is to be sold. It agrees to pay to the members the amount received for the fruit, less charges for handling same. Contracts with growers usually run for five years; some run indefinitely, and a few associations operate with no contracts.

POOLING OF FRUIT.

At this point it is well to point out one of the fundamental principles upon which the Exchange is formed—that is, pooling of fruit of like quality. The success of the Exchange is based, among other things, upon sending to the markets an even supply of fruit throughout the year. This calls for an elaborate sales organization, and plans must be formulated months in advance, taking into consideration crop conditions, probable weather conditions, normal market needs, etc. Obviously a uniform sales policy is essential for the equable distribution in accordance with market possibilities of 24,000,000 boxes of fruit. If each of the 12,500 growers reserved to himself the right of saying when and where his fruit should be sold, the result would be chaos indeed, and the entire Exchange would collapse. In addition, no standard brand such as the Exchange puts out (Sunkist) could be maintained if the grading of the fruit were in the hands of 12,500 growers. At certain times of the year citrus fruits sell very low; a grower shipping on his own account would not ship at such a time, and, consequently, a large excess of fruit would go on to the market when prices adjusted themselves to normal. A certain amount of fruit must go to market at all times, regardless of price, as an absence of California fruit would lead dealers and consumers to turn to Florida fruit. When a product is advertised on a large scale, that product must be kept before the public at all times, or the public will turn to other articles that are available. Estimates of market requirements and routing of cars for a 24,000,000 box crop are problems that are beyond the capability of 12,500 growers acting independently of each other.

Therefore, fruit must be pooled, and the pooling is done by variety, grade, and season. Each association decides its own pools, their length and size. There is no pooling between associations. A pool is conducted, roughly, in the following manner: Pool 5, Navels, to run from 1st January to 1st February. At the end of the period it is found that 1,000,000 pounds of first grade fruit, 2,000,000 pounds of second grade fruit, and 1,000,000 pounds of third grade fruit were handled. For the first grade fruit the receipts, after deducting operating expenses, amounted to £7,000. Grower A had 100,000 pounds of first grade fruit in this pool, so he would receive one-tenth of the money, and so on for the other grades, according to the amount of fruit he had in each pool.

Only the brief outlines of pooling have been mentioned, because of lack of space. This subject is fundamental to true co-operation, and should be carefully studied by growers in this country in anticipation of the day when they will operate on the same scale as the California growers.

Any person can pick oranges, but only trained pickers can do it properly. For this reason, every association handles the picking of the fruit for its members. All fruit is pooled, and it is unfair to growers of fruit which is carefully picked to include with that fruit any that is improperly picked. The latter is much more subject to decay, and any decay in transit brings down the receipts for the pool, thus affecting all growers alike.

Upon arrival at the packing-house the fruit is weighed, washed when necessary, graded, sized, usually weighed again by grade, and packed. At that point the chief work of the local association is completed, and the district exchanges take over the marketing functions.

DISTRICT EXCHANGES.

When the fruit is loaded on to the cars (400 boxes per car), the direct responsibility of the local association ends, and control of the fruit is passed to the district exchanges. There are at present twenty-two district exchanges, the members of which are the local associations. (There are a few large growers operating their own packing-houses who belong to district exchanges.) Each district exchange has on an average about ten member associations, each of which elects one of its own directors to serve as a director of the district exchange to which it belongs. Thus a district exchange formed by twelve locals will have twelve directors; these directors vote according to the number of boxes shipped the previous year by their associations. A manager is chosen by the directors, and in the choice of a manager lies to a large extent the success of the exchange.

The function of a district exchange is primarily to act as a sales agent for the local associations comprising it, such sales to be made through the facilities provided by the central body, the California Fruit-growers' Exchange. The district exchange manager orders all cars for the local associations, and routes all cars which are sent to market. It is in this connexion, routing of shipments, that the chief function of the district exchange lies. In order that the direction of shipments may be carried out properly there must be constant communication between the central body and the district exchange managers as to market conditions and shipments already en route to each market.

METHOD OF SALE.

Two methods of sale are followed; in the one a local association may reserve to itself the right to decide on the selling price, and in the other a local may delegate that right to its district exchange. Thus, in the first case, a car of oranges reaches a certain market, the agent of the central body wires back, via the California Fruit-growers' Exchange, to the district exchange which sent the fruit, the condition of the car and the price offered by dealers, and the local association decides whether or not sale shall be made at that price. In the other case this decision is made by the district exchange itself, the decision coming from the manager.

The district exchanges ad e the locals as to when to ship, where to ship, and how much to ship. Some locals leave these decisions entirely to the district exchange to which they belong, and others

merely ask the district exchange for advice. In all cases sales are made in the name of the district exchange through which the shipment passes. All money goes to the district exchange from the central body for transmission to the local associations. A fixed sum per box (average, 1924, was 1s. 2d. per box) is deducted to cover operating expenses. The assessment is based on a crop estimate and an estimate of expenditure made each year.

Important points to note are: That there is no pooling between locals, the fruit of each local being sold separately from that of other locals; the district exchanges own no fruit and are merely selling agents of the locals; they operate at cost; they are in close touch with the sales force of the central body, and thus are competent to direct shipments both as to destination and time of shipment; in general, they act as intermediary agents between the California Fruit-growers' Exchange and the 210 local associations. Obviously, complete disorganization of any orderly marketing plan would quickly result if 210 local associations were to act independently.

CALIFORNIA FRUIT-GROWERS' EXCHANGE.—THE KEYSTONE.

The keystone binding together these various groups is the California Fruit-growers' Exchange, which is composed of the twenty-two district exchanges. Each district exchange elects one of its directors to serve as its representative on the California Fruit-growers' Exchange; thus the board of directors of the latter organization has at present twenty-two members. Each district exchange binds itself to a definite contract with the central body, the present contracts continuing in force until 1940. Each has the right, however, to withdraw on 1st September of any year; none have ever done so, with one exception that occurred in 1903, when the ill-fated California Fruit Agency was formed.

The California Fruit-growers' Exchange was created to lessen the cost of marketing by forming agencies to act for each member; to ensure the collection of sales accounts (since 1905 total losses have amounted to £5,280 out of a total of £120,000,000 handled); to facilitate the collection of damage claims; to encourage the improvement of the product and the package; to increase the consumption of citrus fruits by developing new markets, and to aid in supplying all the people with good fruit at a reasonable price.

Each district exchange agrees to ship all of its fruit through the California Fruit-growers' Exchange; any fruit not so shipped is subject to liquidated damages of a shilling a box. Each district exchange reserves to itself the right to regulate and control its own shipments, to use its own judgment and decide for itself when and in what amounts it shall ship, to what markets it shall ship, and, except at auction points, the price it is willing to receive. The complete right of free competition with other district exchanges is reserved. On these points is based the democracy of the entire organization, as with these reserved rights there can be no such thing as autocratic control of shipments, prices, or markets. This sound principle does not cease with the district exchanges, as we have seen that many locals reserve this right to themselves in their contract with the district exchanges to which they belong.

THE PERSONAL ELEMENT.

The board of directors (the twenty-two representatives of the district exchanges) choose a general manager, and upon their choice rests to a large extent the success of the Exchange, the progress of the industry, and also the well-being of many other co-operative organizations. The success of the Exchange has admittedly been the stimulus behind organization of producers not only in America and South Africa, but also in many other countries. Any mistake in general policy of the Exchange would have far-reaching effects. The manager chosen must be primarily a business man, and not necessarily one who is familiar with the culture of citrus fruits. This question of management cannot be over-emphasized; I will give one definite example of care in the choice of a manager: About two years ago the Sun Maid Raisin Growers (controlling 90 per cent., or 250,000 tons, of the California raisin crop) was in serious difficulties, and a change in management took place. The new manager took over the work at a salary of £10,000 per year, and to-day the raisin industry is once more back on a sound basis. The present manager is a business man who knows practically nothing about the producing of raisins, but he does know how to dispose of them once they have been produced.

MANY RAMIFICATIONS.

Under the general manager of the California Fruit-growers' Exchange are various departments; these are orange sales, lemon sales, legal, traffic, field, accounting, and advertising; there are also sub-divisions of these, such as claims, routing, rates, inspection of cars, research, educational, grading inspection, growers' service, dealer service, and by-products. The Exchange owns the trade marks "Sunkist" and "Red Ball"; the former is for fine fruit only, and the latter for fruit of standard quality. Fruit from each association goes under the trade marks or brands of the association. Thus one association, for instance, ships fancy fruit as "Pet" brand, extra choice as "Greyhound," standard as "Arab," and a fourth grade as "Duck." The first two grades could, in addition, carry the name "Sunkist" and be wrapped in "Sunkist" wrappers; the third grade would go as "Red Ball"; and the fourth grade would simply go under its own name alone. With definite brands established, it is one of the field department's duties to see that each local association packs according to the regulations for each brand. To allow an association to put out inferior fruit under the name "Sunkist" would seriously injure the status of all "Sunkist" fruit. This trade name is worth at least £2,000,000 to the growers, and the central office must see that the interests of all are fully protected. In general, the field department deals with all problems of grading, packing, harvesting, pest control, and general research.

The legal department advises the Exchange on all legislative matters affecting the industry, on preparation of contracts, by-laws, financing, and organization matters in general. A great deal of assistance has been given to co-operative organization in other industries. To give one example of this point: Representatives from the citrus industry of South Africa were given complete information

and data as to the structure and operation of the Exchange and its constituent parts.

The accounting department keeps all records of transactions and makes a careful study of the selling margins of wholesale and retail dealers. When such margins are high, the amount of fruit sold by a particular dealer is necessarily smaller than would be the case if the margin were lower.

The traffic department assists the district exchanges in car routing, maintains a staff of inspectors along the transcontinental railway lines, and handles diversions. All inspectors report to the head office daily, and thus the exact location and condition of every car is known at all times. During the busy season there may be 2,500 cars en route on any one day, so the work is very comprehensive.

The two sales departments (one for oranges, tangerines, and grape-fruit, and the other for lemons) maintain bonded agents in all of the principal markets of the United States and Canada, and one in London to handle the English and continental trade. In the smaller markets sales are made through brokers. The United States and Canada are divided into six districts, in charge of each being a district sales manager, who has agents in the cities within his district. The Exchange deals with brokers through the district manager in whose territory they operate. All agents operate on a salary basis and receive no commission.

THE INTELLIGENCE SYSTEM.

All district managers keep in daily communication with the central office in Los Angeles and report all sales, movement of cars of non-exchange shippers, movement of competing fruits such as apples, pears, peaches, plums, berries, etc., weather conditions and general market conditions. This information comes from their own observations and from the observations of the sales agents under them. All communication is by telegraph in Exchange code or by telephone; the annual cost of this market news service is over £25,000.

Information reaching the Los Angeles office is classified daily, and during the ensuing night is printed in bulletin form; next morning it is in the hands of each district exchange and local association manager. This Exchange bulletin contains copies of all sales made the previous day, cars en route and their destination, movement of competing crops, and copies of all telegrams received at the central office relating to sales or price adjustments. All of this information goes to all the district exchanges and local association managers daily, and, in addition, weekly and monthly summaries are issued. Thus each manager receives a complete review each day of the market situation in the United States and Canada. The California Fruit-growers' Exchange owns no fruit and makes no sales; it maintains a complete selling system and collects full market information, which goes to all members alike. On the basis of this information the district exchanges, or local associations as the case may be, route their cars and decide at what price they shall sell.

FROM GROVE TO MARKET.

Let us trace a car from grove to market, that the various steps may be clear. Mr. Jones, of Sierra Madre, owns fifty acres of oranges,

which are being picked by a crew of men from the Sierra Madre-Lamanda Citrus Association. The fruit goes to the packing-house, is weighed, washed, graded, sized, weighed again by grade, mingled with fruit from other growers whose fruit is in the house, is packed, and loaded into a freight car. The fruit goes under the brands of the association, and is no longer known as the fruit of Mr. Jones. The manager of the Duarte-Monrovia District Exchange, to which the Sierra Madre-Lamanda Citrus Association belongs, bills the car to Chicago, let us say. He routes the car to Chicago on the basis of the information contained in the bulletin of the California Fruit-growers' Exchange received that morning. Four days later the bulletin shows the car well along the route east and that freezing weather exists in Chicago, with several other cars en route to the same market. The weather in Syracuse is good, and, in addition, the cars en route to that city are just a few under the normal capacity of that market. Immediately, through the California Fruit-growers' Exchange, the manager wires east and diverts the car from Chicago to Syracuse, the manager figuring that his car can be put on the Syracuse market before any other cars going to Chicago could be diverted to Syracuse, as the bulletin shows his car to be about a day ahead of the rest. The Exchange has obtained, after a long legal battle that finally ended in the Supreme Court of the United States, the right to divert cars in this manner with no additional freight charges. All cars going east of the Mississippi River pay the same rate, and now no extra charge is made for diversion, whether the car is diverted once or several times. In Syracuse is a salaried agent of the California Fruit-growers' Exchange who, of course, knows of every car of fruit that is en route to him. Before arrival of this car from the district exchange in question, he gets in touch with the dealers and is made various offers for it. The best he wires back to the district exchange manager, through the California Fruit-growers' Exchange, and the manager decides whether or not he will accept. Various other methods of sales are followed, and in certain of the largest markets all fruit is sold to dealers by auction, as is frequently done on the London market with South African oranges. In this case the fruit simply goes for what it will bring, unless a withdrawal is requested by the shipper in the event that a certain price is not reached.

From the above example three important points can be clearly seen that are of particular import to South African growers. On the market is a salaried salesman of proved ability and integrity working solely in the interests of the citrus fruit shippers of the Exchange; in the hands of the district exchange manager is a daily bulletin giving a comprehensive summary of the entire market situation, with all the important details; and at the head of the district exchange is a man who is able to analyze this market news, and through it to make the best possible sale of the fruit. It must be remembered that the market news supplied by the central office goes to all associations, and that each manager is competing against all the others in regard to his shipments. It is due, among other things, to this competitive co-operation that the Exchange has been able to exist. Each shipper is trying to excel in sending fruit of the highest quality, attractively arranged, and to show a better sales record than is shown by any other manager.

EXPANSION THROUGH ADVERTISING.

One of the greatest benefits of co-operative organization is the resulting ability to carry on advertising on a large scale. That advertising on a large scale is an essential factor in the continued success of the Exchange can be clearly seen from the following statement. In 1890, California shipped less than 2,000,000 boxes of citrus fruits; in 1924, shipments from California totalled 24,000,000 boxes, and, in addition, Florida shipments equalled 20,000,000 boxes, and Italy, Sicily, and Spain sent 5,000,000 boxes. Thus 120,000,000 people consumed 50,000,000 boxes of fruit. Since 1890 California shipments alone have increased 1,200 per cent., while the population increase has been about 75 per cent. People do not increase their use of any product without a definite reason, and in the case of citrus fruits the reasons have been advertising, standardizing, and merchandising in place of the " hit or miss " selling that was the rule before the inception of the Exchange.

The national advertising campaign is conducted on a large scale, the annual appropriation for this purpose being from £100,000 to £200,000, depending on the size of the crop. Advertisements emphasizing the value and many uses of citrus fruits are run in magazines having an annual circulation of about 60,000,000 copies. Newspapers to the number of over 100,000,000 copies carry large advertisements of " Sunkist " and " Red Ball " oranges and lemons. Tramcars and subway trains, station platforms, and billboards are all utilized to spread the message of the Exchange fruit. It is interesting to note that the middle double page, in colour, of the *Saturday Evening Post*, is worth £2,400 per issue; each issue, however, has a circulation of 1,500,000 copies. Medical journals are utilized for the purpose of informing the medical practitioners of the great vitamin-content of citrus fruits and the alkaline reaction of the fruit juice. Farm journals are utilized to reach the rural portion of the population. Last year a million bulletins were distributed to hospitals and nursing schools.

HELPING THE MIDDLEMAN.

This direct advertising is not all that is necessary, as steps must be taken to increase the handling capacity of wholesale and retail dealers selling citrus fruits. The work that the Exchange has done in this connexion illustrates the importance of the middleman between producers and consumers. Instead of trying to eliminate middlemen, the Exchange has spent its efforts on increasing the efficiency of the trade dealers. If a jobber is selling 1,000 cases per week and could sell 2,000, he is slowing up the movement of fruit to just that extent, and the same is true of the retailer. If a retailer is selling oranges on a 50 per cent. margin and could reduce this margin to 30 per cent., he will sell much more fruit.

A few years ago the Exchange created a Dealer Service Department under the control of the advertising department. At the present time, seventeen dealer service men are stationed in various sections of the country, and it is their function to show dealers, wholesale and retail, how to buy more advantageously, how to sell better, and how to make more money out of citrus fruits. Increasing dealers'

profits means reduction of price in most cases, thus creating a rapid turnover of the product. A moderate profit from many sales means more money than a high profit from few sales, and at the same time it means that the citrus crop moves more rapidly to a greater number of consumers. Wholesale and retail dealers handle a multitude of products, and consequently can give special attention to none. Here it is that the dealer service man proves his value. The advertising department furnishes the men with thousands of attractive display cards, posters, and decorative material. With the aid of these the dealer service men can quickly transform a mediocre store into one whose beauty is most emphatic. A fundamental principle understood by all is that attractively arranged fruit of good quality and at the right price will sell many times as rapidly as fruit sold under insanitary, drab conditions. The importance of this type of work is evident from the fact that the Exchange spends £50,000 on it alone.

QUANTITIES FOR JUICE.

For many years citrus growers have wanted a juice extractor that would work automatically and would sell at a low price. The Exchange now manufactures an electric machine selling for £9; 20,000 have been sold to date and are in use in private homes, hotels, soda fountains, clubs, ocean liners, etc. Each machine uses about fifty boxes of fruit per year, and a conservative estimate of the amount of fruit disposed of through the use of these machines is 700,000 boxes per year.

COVERED BY 6D. PER BOX.

The writer has presented in very brief form the main activities of the Exchange, and has attempted to show the elaborate system of organization and the far-reaching scope of the Exchange activities, but lack of space prevents more detailed treatment, and, in fact, necessitates the omission of such subsidiary organizations as the Fruit Growers Supply Company (total business, 1924, of £2,000,000; owns 70,000 acres of virgin forest, etc.), the Exchange Orange Products Company, the Exchange Lemon Products Company, mutual fire insurance scheme, bud selection work, etc. All points covered, and many not mentioned, are of vital interest to South African growers, and the obvious question at this point is concerning the cost of these large-scale operations. The following table gives the cost of Exchange service for different years. It is a negligible point, as 6d. a box covers everything, even including such an appropriation as £200,000 for advertising. The cost of marketing has never been over 3 per cent. of the delivered value of the fruit; compare this with the ordinary commission charge of from 7 to 10 per cent. Included in the 3 per cent. charge, or less, of the Exchange are many services such as advertising, market news, collection of claims, legal power, field service, research, etc., that commission men can never offer.

Year.	Exchange Shipments.	F.O.R. Value.	Costs per Box Oranges.				Per Cent. Crop Handled.
			C.F.G.E.	Advertising.	District Exchange.	Total.	
		Dollars.	Cents.	Cents.	Cents.	Cents.	
1904-05	5,189,000	7,124,000	—	—	—	—	47
1910-11	10,843,000	20,708,000	—	—	—	—	61
1912-13*	4,900,000‡	13,500,000	—	—	—	7·33	61·5
1913-14*	11,262,185	19,246,757	4·25	1·5	·85	6·60	61·9
1914-15*	11,889,836	19,537,850	4·25	2·0	·91	7·16	62·5
1915-16	12,101,520	27,703,000	4·65	2·5	1·00	8·15	67
1916-17*	15,492,340	33,611,000	3·85	2·2	·81	6·91	69
1917-18*	8,644,177§	36,422,200	5·25	2·0	1·25	8·50	76
1918-19*	14,855,095	55,000,000	4·26	2·5	·94	7·60	72·3
1919-20*	15,823,764	51,221,329	5·51	2·5	1·12	9·13	73·7
1920-21*	18,226,886	56,904,263	5·95	3·5	1·08	10·53	72·5
1921-22*	11,617,003‡	48,647,800	7·70	3·5	1·80	13·00	68·7
1922-23†	17,857,417	55,223,451	5·44	4·0	1·42	10·86	75·8
1923-24†	19,388,280	50,515,497	5·45	4·5	1·41	11·36	72·9‖

From the above table the increase in shipments can be clearly seen, and in the last column is seen proof of the continued success of the growers' organization. No organization of producers can hope to gain members year after year unless it confers direct financial benefits upon those who support it. The Exchange has increased its membership from 23 per cent. in 1896-97 to 73 per cent. in 1923-24.

The financing of the central organization is very simple, as all expenses (salaries of general manager and other employees, rental of offices, departmental expenses, advertising, telephone and telegraph charges, etc., usually amount to about £300,000 a year) are paid by the collection of a per box assessment, all fruit sold paying a uniform rate. At the beginning of the crop year (1st November to 31st October) an estimate is made of the boxes to be shipped, and an assessment is then made sufficient to cover the estimated expenses for the year. At the end of each month every district exchange or local association or private company affiliated directly with the Exchange is presented with a bill based on the number of boxes shipped by each during the previous month. (Certain local associations and large growers operating their own houses are so situated geographically as to preclude their joining a district exchange. Such isolated associations or individuals affiliate direct with the California Fruit-growers' Exchange and have the same status as district exchanges, except that they send no director to the central body.) All money received for fruit on the market passes through the central office, and is remitted in full to the district exchanges. At the end of the year any surplus or deficiency arising from the assessment is put to the account of the shippers according to the boxes shipped by each. Any

* From Annual Reports, General Manager G. Harold Powell.
† From Annual Reports, General Manager E. G. Dezell.
‡ Crop loss due to cold.
§ Crop loss due to heat.
‖ Figures represent percentage of shipments; an actual membership gain has occurred yearly.

temporary deficiency is made up by bank loans, the name of the Exchange being sufficient security.

THE LESSON FOR SOUTH AFRICA.

The value of the California Fruit-growers' Exchange to the citrus growers of California is self-evident from the outline which has been given. Without the Exchange the citrus industry of the State would not exist on one-tenth the scale it does to-day. Can the application of the co-operative principles of organization upon which the Exchange is built be of service to South Africa? The export of oranges from South Africa, as previously mentioned, amounted to roughly 500,000 cases for 1924, and many difficulties stood in the way of the successful shipment of this small crop. Extensive planting of new trees has been going on and will continue for a considerable period of time. By 1930, the crop to be handled will amount to about 7,000,000 cases, or, in other words, in five years the citrus crop will increase 1,200 per cent. Five years will certainly not see the limit crop, because a large amount of planting is going on all the time. The recent visit of Dr. Webber will undoubtedly lead to yet further increasing of the citrus acreage.

South Africa need have no fear that the large crops of the very near future will not be marketed successfully provided that certain steps are followed. Agricultural enterprise can be divided roughly into two divisions, that of actual production and that of marketing. This country can and is producing citrus fruits successfully, and at the present time is disposing of those crops profitably. The problem before the industry is whether or not the growers can market at a reasonable profit the large crops of the near future. The question is by no means a new one, as the California growers went through the same, and probably worse, trials. A true co-operative organization of producers, and producers alone, governed by men of unlimited capabilities and judgment, based on sound principles and unswerving loyalty of the members, can solve the marketing problems that will come into being in the next few years.

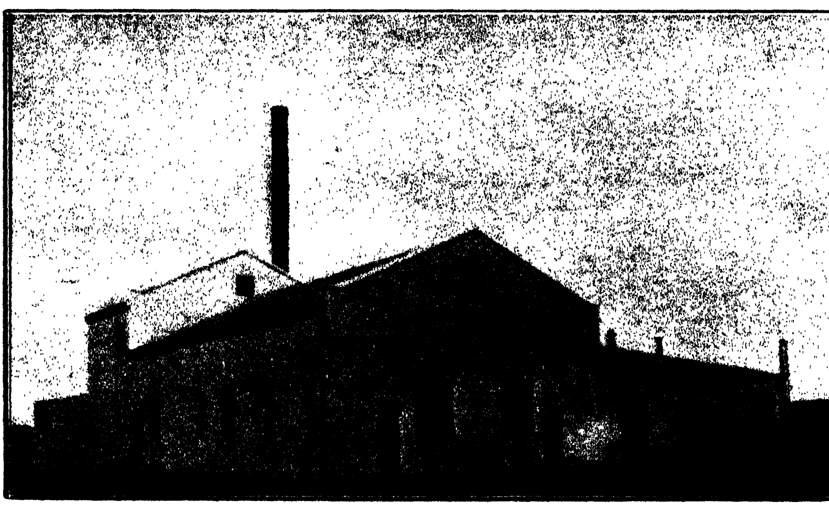
In one clear-cut sentence, I can give the steps to be followed; in it is contained the solution of the marketing problems of agricultural producers of specialty crops the world over, when they are faced with the vital problem of disposing of a rapidly increasing output; it is a solution that has been tried, subjected to the most adverse opposition by opposing interests, and has not been found wanting—

ORGANIZE AND ADVERTISE TO MERCHANDISE A STANDARDIZED PRODUCT!

DEHYDRATION OF FRUIT.

The Beginning of an Important Industry.

FRUIT-DRYING in the eastern Cape Province is likely to become an industry of large dimensions in the near future. Weather conditions at harvesting time may demand the use of artificial dehydration; in fact, a large plant has already been erected at Golden Valley, Longhope, for this purpose. A visit was recently paid to the area by Mr. L. Perkins of the Elsenburg School staff, and some dehydration tests were made with pineapples and pumpkins, using the plant



[*Photo L. Perkins.*

General View of Dehydrator.

mentioned. Mr. Perkins reports that the situation in most of the south-western districts of the Cape Province is unlike that in the eastern Cape districts, the Orange Free State, and Transvaal, because in the latter areas sun-drying is practically out of the question, hence artificial drying has become a necessity. In the western Cape districts sun-drying is possible in nearly all the fruit-raising sections, and may generally be practised with safety to dry the whole of the later crops. Sun-drying has been extensively established for many years, but as dehydration, in certain circumstances, might be the more suitable method, closer competition between dehydration and sun-drying may be expected in the near future.

Whether dehydration of fruits in the western districts of the Cape Province will demonstrate its economic right to exist and flourish, experience only will show. Under summer rainfall conditions, however, dehydration will be the salvation of the grower's crop,

and it is undoubtedly going to aid in the production of a fruit low in sulphur dioxide content.

The advantages of dehydration of fruit are:—

1. It produces the finest quality of dried fruit, giving an hygienic and non-contaminated product.

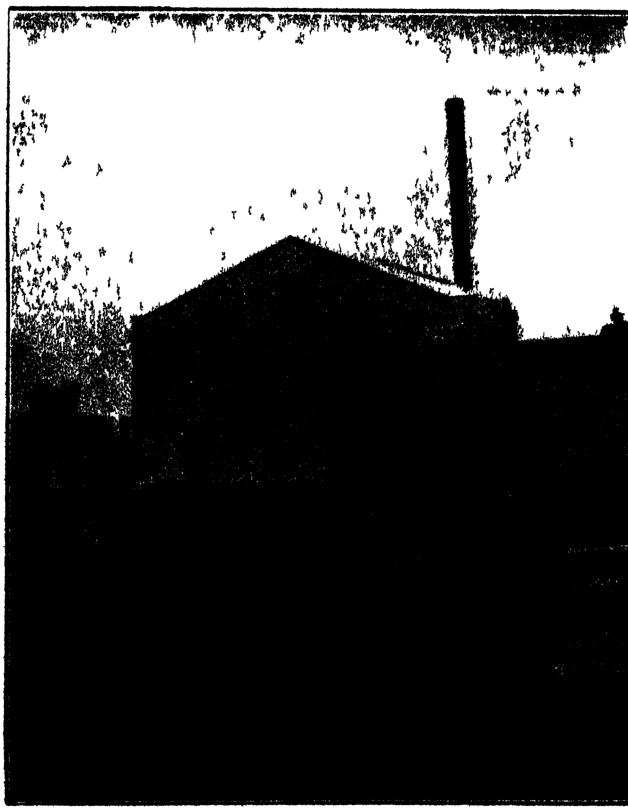
2. Crop assurance under abnormal weather conditions.

3. Rapid and uniform drying under continuous operation.

4. Low cost of operation per ton capacity.

5. Small amount of skilled labour required.

6. Production of the maximum yield, there being the least shrinkage.



[Photo L. Perkins.

Trays Stacked for Sulphuring

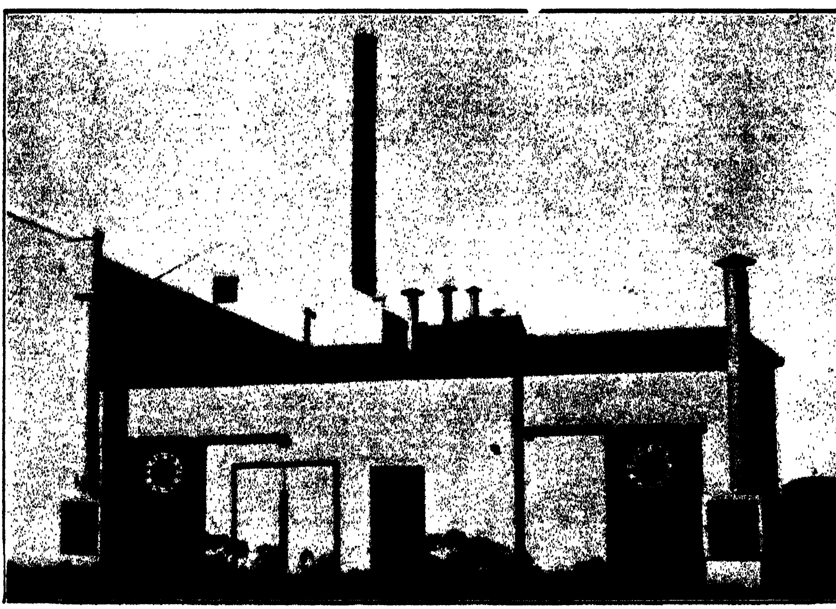
DEHYDRATION OF FRUIT EXPERIMENTS.

During the past season an officer of the Elsenburg School of Agriculture visited Longhope, and there started in operation one of the first commercial dehydration plants in the Union. The accompanying photographs illustrate the size and appearance of the plant. This plant is designed to handle 25 tons of apricots per day.

Pineapples were cored and sliced in half-inch pieces, the first trolly entering the first compartment at a temperature of dry-bulb reading 135 degrees F.; wet-bulb reading 120 degrees F., which gave a relative humidity of 60 per cent.

There are six compartments to each tunnel, and each trolly remains opposite each fan for 1 hour 20 minutes, the drying time, therefore, from entry to finish being eight hours. The finishing temperature in the last compartment never rose above 165 degrees F. dry-bulb, and 110 degrees F. wet-bulb, giving a relative humidity of 18 per cent.

Before placing the fruit in the dehydrator, several bleaching treatments were given, viz.:—1st, brine alone; 2nd, sulphuring and brine; and 3rd, sulphuring alone. Of these, sulphuring plus brine



[*Photo L. Perkins.*

Entrance to Tunnels.

gave the best results, using 3½ lb. of sulphur per 480 cubic feet for 2 hours; brine dip 4 oz. of salt per gallon of water.

The fans were reversed every two hours, but this did not give as good results as running alternate fans on exhaust while the balance operated on blast during the whole run. This latter method was also more efficient, as no time was lost by shutting down and making electrical alterations.

After eight hours the pineapples were perfectly dry, with no visible signs of scorching, the drying being perfectly uniform. This is the first instance of satisfactory commercial dehydration in South Africa.

Pumpkin was peeled, cut into chips, and dipped into a brine solution with no sulphuring. It was found that the finishing temperature for pumpkin could be raised to 170 degrees F. dry-bulb,

with a wet-bulb reading of 110 degrees F., giving a relative humidity of 16 per cent. with no ill effects. The finished product was perfect, with a rich orange colour. If ground into a flour a considerable trade might be developed by using it as a soup thickening, similar to the famous pea-flour.

Commercially, the pumpkins are cut in half with large knives and the seeds and seed cavity pulp removed. The unpeeled halves are sliced or shredded in a silage cutter or other heavily constructed cutting-machine, into pieces about ¼ inch thick. In most factories the pumpkin, according to Cruess, is not bleached, but the colour is greatly improved if the slices are steamed on the trays until heated through. It was found that brine dipping was equally efficient.

This vegetable is dried until very dry, less than six per cent. moisture, and is ground in an attrition mill before it can absorb moisture and become leathery. The ground product is bolted or screened to remove the coarse particles, which are reground. The resulting flour is packed in small envelopes for household use or in large friction top cans for restaurant and hotel use.

Dehydration in the eastern districts of the Cape Province is essential, and it is considered that before long many such machines will be operating there. The present dehydrator represents only 1/60th of the plant that will be required to dry the crop the present acreage should produce. Dehydration will therefore become an important industry, for it will be necessary to handle 2,000 tons per day during the apricot season.

Apricots may be followed by apples, pineapples, vegetables, such as pumpkin, etc., in order to keep the dehydrators busy over a longer period of the year, thus reducing considerably the overhead charges. (*Elsenburg School of Agriculture.*)

List of Nurseries in Quarantine at 1st July, 1925.

Name.	Address.	Cause of Quarantine.	Extent of Quarantine.
J. W. Patrick	Newlands, C.P. ...	Circular Purple Scale	Palms and Aspidistra, all.
W. A. Sturm	Craighall, Johannesburg	Crown-gall and Root-gall Worm	Deciduous, all.
Sunnyside Farm ...	Louis Trichardt ...	Red Scale ...	Citrus, all.
D. J. Conradie & Bros.	Robertson, C.P. ...	Red Scale ...	Citrus, all.
A. S. Strydom & Co. ...	Krakeel River ...	Woolly Aphis ...	Deciduous, part.
Craighall Estate Nursery	Craighall, Johannesburg	Pernicious Scale...	Deciduous, all.
G. J. Labuschagne ...	Groot Marico ...	Red Scale ...	Citrus, all.
Chas. Howie & Co. ...	Johannesburg ...	Pernicious Scale...	Deciduous, part.

THE FUNGOUS DISEASE OF LOCUSTS.

Report on a Preliminary Investigation in South-West Africa.

By S. H. SKAIFE, M.A., M.Sc., Ph.D.

THE RECENT OUTBREAK.

EARLY in March of the present year reports were received from South-West Africa by the Division of Entomology that locusts were dying there in large numbers of a virulent disease. From specimens sent in it was possible to determine that the insects had died of a fungous disease, but the exact specific organism could not be identified from the scanty dried remains that were received. As a result of the persistent reports of a widespread mortality among the locusts, the Minister of Agriculture arranged with the Cape Provincial Administration that the present writer should be sent to South-West Africa in order to carry out a preliminary investigation as to the exact nature of the disease and the extent of the outbreak. The results of this preliminary investigation are embodied in the following article, together with certain details that were the results of previous investigations.

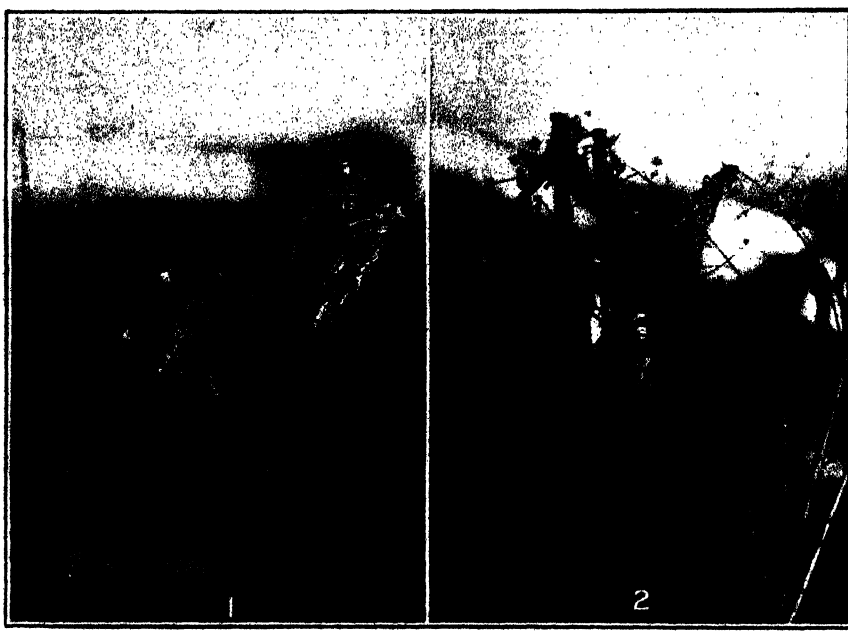
The 1925 season promised to be a very serious one for South-West Africa as regards locusts. As a result of the good rains, eggs hatched extensively, not only in the occupied areas, but also in the vast, unoccupied regions known as the Namib, the Kaokoveld, and the Kalahari. The whole country was overrun with the pest, and a campaign against them was organized on a large scale. The situation was critical when, in March, reports began to come in from the northern districts of Grootfontein, Otjiwarongo, Outjo, Omaruru, Karibib, Okahandja, and Gobabis that the locusts were dying in immense numbers from a mysterious disease. It appeared to a slight extent around Windhoek, but was not reported at all from any of the districts to the south of Windhoek.

So deadly was the epidemic that in a short time the northern half of the country was almost completely cleared of the locusts, and the large supplies of poison that had been rushed forward were no longer necessary. Early in May the rains ceased, and with the cessation of the rains the disease disappeared completely. Similar reports of an epidemic among the locusts were received at the beginning of April from the Bechuanaland Protectorate, where, it was said, the locusts were dying all the way from the beacon on the 21st parallel, southern latitude (Stigand's map), to Maun, and the same condition was said to exist in all other parts of Ngamiland.

THE CAUSE OF THE DISEASE.

The epidemic among the locusts was due to a parasitic fungus known to science as *Empusa grylli*. This organism is well known

and widely spread in the Union of South Africa and other parts of the world. It belongs to a family of fungi the members of which are nearly all parasitic on various kinds of insects. Wherever it occurs, the fungus in question makes its appearance among locusts and grasshoppers whenever the climatic conditions are favourable to its development. For example, it shows up regularly at Cedara, Natal, every year between December and March, and large numbers of grasshoppers die of the disease. Usually the disease attracts but little notice, but during the past season the highly favourable warm, moist conditions in South-West Africa, together with the severe infestation of locusts, brought about a very striking epidemic among the insects that attracted general interest and attention. Whole swarms



THE LOCUST FUNGUS.

FIG. 1.—Diseased locusts climbing on to the twigs of a bush just before dying.

FIG. 2.—Locusts that have died of the disease. Note the characteristic manner in which the dried, shrivelled bodies remain clinging to the stems.

were almost completely destroyed, and the innumerable dead bodies clinging to the grass and bushes could not escape the notice of the most casual observer.

Locusts dying of the disease have a curious and well-marked characteristic. They all climb as high as they can on the grass stems and twigs of bushes and die in these elevated positions, with their heads pointing upwards towards the sky (fig. 1). Just before death they loosen their hold with their claws and embrace the stems with their legs. After death, the legs stiffen and the dead bodies remain hanging in this position for some days, until they are finally blown away by the wind or washed down by the rain (fig. 2).

THE MANNER IN WHICH THE DISEASE SPREADS.

Another remarkable characteristic of the disease lies in the fact that the great majority of the locusts infected by it die in the late afternoon. Dying locusts can rarely be found climbing up the grass stems before noon, and none of them seem to die until 3 p.m. or later. The significance of this will be understood when the manner in which the disease spreads is studied.

A few hours after death a fine, white, furry growth appears on the dead body, growing from the thin skin at the joints and between the segments of the abdomen. If this furry growth is examined under the microscope it is found to consist of innumerable fungous threads that project from the insect's skin like close-set, short, stout hairs (fig. 4d). On the top of each thread a pear-shaped spore, or reproductive body, is produced. This pear-shaped spore, 25 to 45 microns in length (about one seven-hundredth part of an inch), with

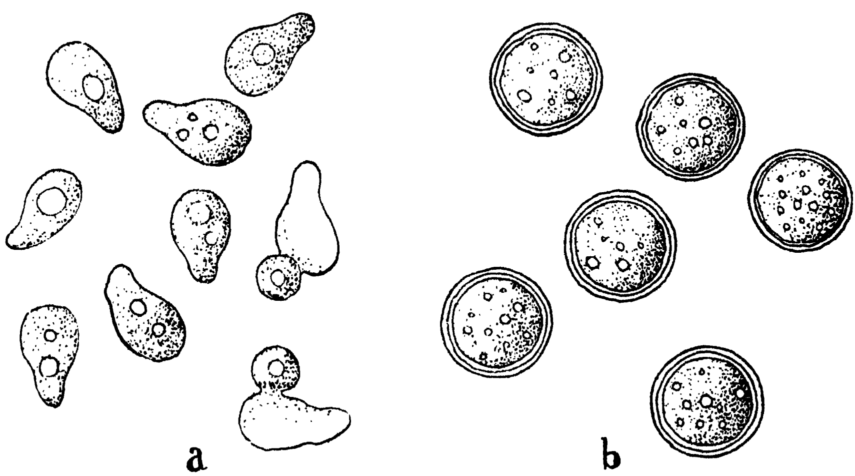


FIG. 3.—THE LOCUST FUNGUS.

a. The pear-shaped spores that are thrown off in immense numbers from the body of a locust that has died of the disease. Note the large drops of oil which each one contains and which serve as food material. The two spores shown on the right have produced secondary spores.

b. The spherical resting spores that are produced inside some of the dead bodies. The thick, double outer wall enables these spores to withstand dry conditions. (Both very highly magnified.)

one or two large oil globules contained in it, is characteristic of *Empusa grylli* (fig. 3a).

The thread bearing the spore absorbs moisture and swells consireably until finally it bursts. The spore is thus shot off to a considerable distance and the thread that bore it collapses. In this way a bombardment of spores occurs, ejected in all directions from the body of a dead locust. This happens almost invariably at night, when the locusts are all clustered together. Many of the living locusts in the immediate neighbourhood of the corpse get struck by the spores. When it is thrown off from the thread, each spore carries with it a portion of the contents of that thread, consequently

it is sticky and adheres to any object against which it happens to strike.

If the weather conditions are favourable, the spore that reaches a living locust germinates very quickly and gives off a fine thread which pierces the outer skin of the insect and enters its body. In this way numbers of healthy locusts can be infected from one dead individual in their midst.

The spores that do not come into contact with locusts, but which strike against the surrounding vegetation or fall to the ground, are not necessarily ineffective. Under suitable moist and warm conditions they also germinate, but instead of producing a fungous thread, each one produces a smaller spore, borne on a short stalk (fig. 3a). This secondary spore is thrown off in its turn and may reach and infect a locust. Possibly the secondary spores that fail to reach their mark may germinate and give rise to tertiary spores, but the present writer has failed to confirm this. By catching the primary

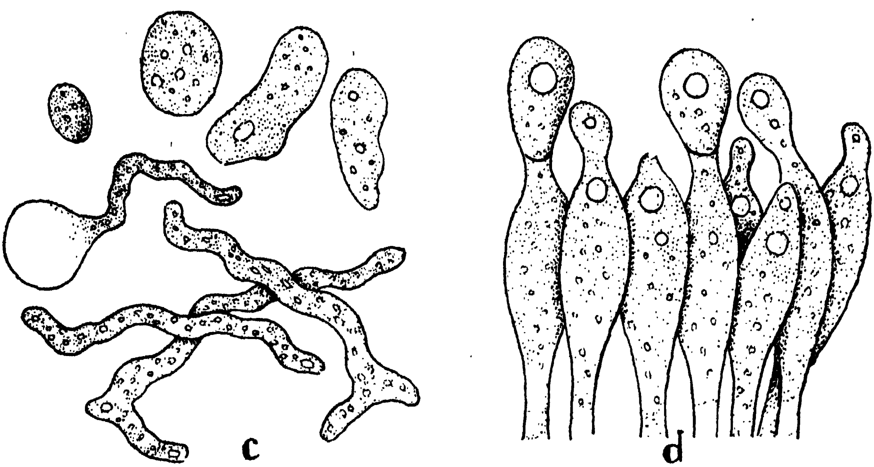


FIG. 4.—THE LOCUST FUNGUS.

c. The fungus as it appears inside the body of a dying locust. The short, stout hyphal bodies grow out as shown and produce the long, thread-like bodies.

d. The thread-like bodies pierce the skin of the dead locust and produce the white furry growth, part of which is shown here. Each thread swells up and becomes club-shaped, whilst a pear-shaped spore is produced at the tip of each. (Both very highly magnified.)

spores from a dead locust on a glass slide and placing them under moist conditions, the formation of the secondary spores could be readily followed, but attempts to produce tertiary spores all failed.

THE DEVELOPMENT OF THE DISEASE.

The period that elapses between the time of infection and the death of the insect has not been determined. From casual observations it would seem that death occurs some five or six days after the locust has been infected. The diseased insect shows no signs of distress until a few hours before its death. Active and apparently healthy locusts have been caught and microscopically examined in the laboratory. In the bodies of some of these large numbers of

fungous threads have been found, showing that the disease had reached an advanced stage in these individuals, yet they had shown no sign of it by their behaviour in the field.

The fungus inside the body of the sick locust is in the form of short, thick threads that are entirely separate one from another. These are found in all the tissues in all parts of the body and have a dense, granular appearance as though they are laden with food material. In the earlier stages of the disease, hyphal bodies (as the separate portions of the fungus are called) are generally of a spherical or oval shape, but as the disease progresses, they elongate and some of them give off one or more short branches (fig. 4c).

Just before death ensues, the abdomen of the diseased locust appears to be slightly swollen, and at this stage the insect becomes sluggish and begins to creep up on to the grass stems. If the body contents of such an insect are examined under the microscope, it is found that the hyphal bodies have destroyed nearly all the tissues and occupy practically the whole body. It is remarkable that the insects can survive and move about until such a stage of infection is reached. Each hyphal body begins now to elongate rapidly and take on a thread-like form. The insect dies and the threads pierce the thin integument at the joints and between the segments of the abdomen. Finally the pear-shaped spores are produced as described above.

Numbers of hyphal bodies fail to grow out to the exterior; possibly they are unfavourably situated inside the body and are crowded out by the others. After the spore-production is over, the dead body dries up, and the white, mummified corpse remains hanging to the grass for some time. If such a body is examined the fresh-looking hyphal bodies that have failed to germinate can be found in it, but these never seem to develop any further and eventually they dry up and disappear.

WHAT STAGES OF THE LOCUSTS ARE ATTACKED?

It has been asserted that the fungous disease attacks only spent individuals that have finished mating and egg-laying and that, in consequence, it has but little effect in controlling the locusts. This, however, is quite wrong. Locusts in all stages, from second stage voetgangers to adults have been found dead of the disease. In the recent outbreak in South-West Africa the great majority of the insects killed were voetgangers in the third, fourth, and fifth stages.

Besides locusts, all kinds of short-horned grasshoppers are liable to the disease. According to Thaxter, an American authority on these diseases, butterflies, moths, and flies are also attacked by *Empusa grylli*, but the present writer has only found it on short-horned grasshoppers in this country. So far, no long-horned grasshoppers have been found to be attacked by the disease. The koringkriek, or dikpens (*Eugastes* sp.), was very abundant in South-West Africa this year, but not one was found to be infected with the fungus.

THE DORMANT STAGE OF THE FUNGUS.

A small proportion of the locusts that die of the disease (roughly about one per cent. of the cases observed) fail to throw off spores in the usual manner. The hyphal bodies do not grow out through

the integument, consequently no external white, furry growth appears on the dead body. If such a dead locust is dissected and examined under the microscope, it is found that the great majority of the hyphal bodies have produced regular spherical bodies, each of which measures about 30 microns in diameter (just over one-thousandth part of an inch) (fig 3b). These bodies are known as "resting" spores, for each one is enclosed in a double, thick wall that enables it to withstand adverse conditions, and this is the form in which the fungus passes through the periods of drought. The soft, delicate, pear-shaped spores that are thrown off to the exterior soon shrivel up and die under dry conditions, but the tough resting spores can apparently survive for long periods.

In the course of the investigations recently carried out in South-West Africa it was found that the disease seems to disappear completely immediately after the rains cease, but among a large number of living locusts that were caught and examined some individuals were found that were infected with the hyphal bodies. Judging from observations made on caged specimens, it would seem that these individuals had been infected too late in the wet season for the disease to run its usual course; the rains had ceased before death had overtaken the insects. Nevertheless, the insects eventually died of the disease, but, owing to the dry conditions, the external furry growth did not appear, but numerous resting spores were produced inside their bodies.

Thus, from a small percentage of those locusts that die of the disease during the wet weather and from all those that die just after the cessation of the rains, countless numbers of the spherical, resistant resting spores are produced. With the decay of the dead bodies these get scattered over the veld, and it is thought that they serve to start the disease afresh as soon as favourable climatic conditions return. On this point, however, further research is necessary, for so far all attempts to get the resting spores to germinate artificially have failed and we have no knowledge of the conditions that are necessary to induce these spores to grow.

CAN THE DISEASE BE UTILIZED ARTIFICIALLY?

Empusa grylli is undoubtedly one of the most important of the natural enemies of the locust, and the past season's experience has shown that it can, when the climatic conditions favour it, kill off the insects in vast numbers. The question at once arises: "Can not this disease be cultivated artificially and used in the campaign against the locusts?" The answer to this question is that, unfortunately, in the present state of our knowledge we cannot utilize the disease artificially. In the first place it is entirely dependent on the climatic conditions for its development. The fungus will not grow unless the atmosphere is warm and moist, therefore we could not hope to start an epidemic among the locusts during dry or cold weather.

Secondly, all attempts to grow the fungus artificially have so far failed entirely. The present writer tried persistently for over a year to grow it on various culture media, but with no success, and workers in other parts of the world have met with similar results. Twenty-five years ago two workers in Grahamstown claimed to have succeeded in growing the fungus, and the spores that they obtained from their culture-tubes were distributed to farmers in various parts of the

Union. Eventually those spores proved to be the spores of a contaminative mould that had got into the tubes and not the spores of *Empusa grylli* at all.

Nevertheless, it cannot be asserted dogmatically that the fungus will never be propagated artificially. Further research may reveal the cause or causes of previous failures and a method of growing *Empusa* artificially on a large scale may be evolved. If this is done, then the spores could be disseminated among the locusts as soon as favourable conditions prevailed. Thus an epidemic might be started among the locusts earlier and on a larger scale than if Nature were left to work unaided.

Finally, we need more knowledge as to the exact manner in which the fungus tides over the long dry periods. Do the resting spores, after lying dormant in the dust all this time, germinate as soon as the rains come and start the disease directly? Or does the fungus go through some intermediate stage about which we know nothing at present? Or do the locusts swallow the spores through eating contaminated food, and do the first to die of the disease contract it in this manner? If we could answer these questions we might be in a position to devise some means of starting the disease among the locusts sooner than it would appear among them naturally. When the disease once enters upon its virulent stage, it spreads with lightning-like rapidity and deadly effect, but it seems to take some time for it to arrive at this stage. During the past season in South-West Africa the heavy rains started in January, but the disease was not reported until two or three months later. What was the fungus doing during this intervening period?

CITRUS CANKER ERADICATION.

INSPECTION WORK, JUNE, 1925.

Farms Inspected—

Rustenburg District (Hex River Ward).—Buffelspoort No. 668, Roodekopjes No. 171, Zuurplaat No. 822, Sandfontein No. 548, Bokfontein No. 647, Boschfontein No. 381, Moddersspruit No. 697, Groenkloof No. 418, Buffelsfontein No 205, Elandsdrift No. 284, Middelkraal No. 385, Elandskraal No. 321, Buffelshoek No. 900, Rustenburg Town Lands.

Pretoria District (Crocodile River Ward).—Strydfontein No. 606, Wildebeesthoek No. 120–611, Vrede No. 199, Hartebeesthoek No. 524, Wonderboom No. 311, Pretoria North, De Kroon No. 420.

Fresh Outbreaks.—Nil.

Total number of trees inspected, 126,204; total number of nursery trees inspected, 105,366; total number of trees found infected, nil; number of inspectors engaged, 14.

INQUIRIES AND REPLIES.

SELECTED LETTERS FROM FARMERS.

[Hereunder are a number of recent letters replied to by the various Divisions and Schools of Agriculture concerned. They are selected for publication as being of interest to farmers generally in the localities affected. In each case the area only from which the inquiry emanates is given; as the replies must necessarily be curtailed, they will indicate, when required, literature from which further information may be had. All departmental bulletins quoted are obtainable on application to the Editor.]

Lichens in Trees.

Sterkstroom.—I am enclosing a sample of a growth found on fruit and other trees (cypress) on a farm in this district. The specimen was taken from a plum tree. The growth is not only on the stem, but all over the trees. As a result of this the trees are beginning to die away. What is the remedy?

Grootfontein School of Agriculture replies: The growth seen on your trees is known as lichen. It is a non-parasitic organism, but injures the trees by excluding light and air from the stems.

The trees may be easily cleaned by spraying with a strong solution of bordeaux mixture (5-5-45 strength). This, however, should not be used on some of the common fruit trees such as the peach when they are in foliage, as the leaves are liable to be burned by the spray. In winter, when the leaves are off, it is quite safe to use. Trees with tough leaves, such as citrus (orange, etc.), or cypress, can safely be treated at any time.

In winter the best spray to use on all deciduous trees (i.e. trees that lose their leaves) is one pound of copper sulphate (bluestone) dissolved in 25 gallons of water. This is even more effective than bordeaux, but must on no account be used on any tree bearing leaves. It will also tend to keep the fruit trees free from fungous disease.

Selecting Seed-maize.

Koster.—Is it essential that the front end of the cobs for seed-maize should be removed when selecting seed on the field?

Potchefstroom School of Agriculture replies: The removal of the front ends of cobs for seed maize is only for the purpose of allowing the seed to pass through the planter more easily. The seeds at the front ends are just as good for planting as those in the middle of the cob, the only difference being that the seeds at the extremity are so small that they have not got sufficient food material to give the new plant a good start. The statement that the small seeds at the point will give rise to plants bearing small and inferior seeds is erroneous. Genetically there is no difference between the seeds at the point and those in the middle of the cob.

NOTES FROM THE "GAZETTE."

Attention is drawn to the following matters of interest which appeared in the *Union Government Gazette*:—

(Abbreviations: "Proc."-Proclamation. "G.N."-Government Notice.)

Gazette. No.	Date.	*Items.*
1482	12/6/25	*Recovering Fencing Costs.*—Rates of payment have been determined and are due in respect of certain dividing fences in Umzimkulu and Middledrift, where various native locations and other properties are involved. Payments are to be made by certain specified dates in 1925 and 1926. (Proc. No. 130.)
		Services of Sheep and Wool Experts.—A revised tariff of fees for the services of Government sheep and wool officers in connexion with the classification or inspection of stud sheep has been laid down. Particulars of these tariffs are obtainable on application to the Secretary for Agriculture. (G.N. No. 954.)
1483	19/6/25	*Export of Lucerne Hay and Lucerne Meal.*—In terms of the provisions of the Agricultural Produce Export Act, lucerne hay and lucerne meal have been included in the schedule of articles classed as agricultural produce suitable for export. (Proc. No. 140.)
		The regulations defining the grades and qualities of lucerne hay and lucerne meal which will be acceptable for export purposes have come into operation as from 1st June, 1925. They also provide for proper baling, packing, inspection, certification, and charges, as well as the extent of Government responsibility. (G.N. No. 1005.)
		Costs of Dividing Fences.—Contributions towards the cost of dividing fences have, in terms of the Fencing Act Amendment Act of 1922, been declared obligatory in Wards Elands River and Klein Winterhoek, Uitenhage Division (Proc. Nos. 143, 147); in Ward No. 6, Richmond Division (Proc. No. 144); in Wards Nos. 3 and 4, Victoria West Division (Proc. No. 146).
		Inland Grading of Export Citrus Fruit.—The Zeerust railway station in the District of Marico has been designated as a centre at which notice must be given of intention to export citrus fruit for purposes of inspection by the Government Fruit Inspector. (G.N. No. 1035.)
1483 1485	19/6/25 26/6/25	*Compulsory Stock Dipping.*—Disinfection and dipping of stock has been ordered as follows: (*a*) Every five days in the five-day dip for various Reserves in Eshowe and Empangeni Districts; also for portions of Pietermaritzburg, Vryheid, Umfolozi, Umvoti; (*b*) every fourteen days in the fourteen-day dip for certain defined areas in Worcester. (G.N. Nos. 1036, 1037.)

Gazette. No.	Date.	Items.
1485	26/6/25	*Export of Sunflower Seed.*—On the 23rd June, 1925, regulations came into force regarding the export of sunflower seed. Grades, classes, and containers are described; inspection and other matters are also regulated. (G.N. No. 1054.)
		Plant Importations.—An amendment has been made to the Plant Import Regulations, providing for introductions of *Backhousia citriodora* in certain numbers, subject to certain quarantine and other protective restrictions. (G.N. No. 1075.)
		Stock-buying in Bechuanaland.—Under the Bechuanaland Purchase of Stock Proclamation of 1923, it has been ordered that licences issued under the said Proclamation shall be issued from 1st July to 31st December, 1925, without the payment of a fee. (*Off. Gaz.* No. 1245, H.C. Notice No. 106.)
1486	3/7/25	*Crown Lands for Disposal.*—The Department of Lands, Pretoria, announces the availability of Crown lands in the Districts of Pretoria and Bethal. Applications to reach the Secretary for Lands not later than 14th August, 1925. (G.N. No. 1126.)
		Management of Forests on Native Area Commonages.—Regulations now provide for the control and management of forests on commonages of all native locations in the Districts of Barkly West, Hay, and Herbert. The regulations name the species of trees and shrubs concerned, amount of wood it is permissible to remove under certain prescribed conditions, and the licences and licence fees payable.
1486	3/7/25	*Brands Registration, Orange Free State and Cape Province.*—The brands registered in the Orange Free State for the quarter ended 31st March, 1925, are scheduled in G.N. No. 1114, and those for the same period for the Cape Province in G.N. No. 1115.

STAFF: APPOINTMENTS, CHANGES, ETC.

1/4/25 *D. J. Retief*, appointed Dairy Inspector at Pretoria.

18/4/25 *P. Koch*, Manager, Rustenburg Tobacco and Cotton Experimental Station: appointed Acting Chief, Tobacco and Cotton Division during absence on leave of W. H. Scherffius.

11/5/25 *F. G. C. Tooke*, Entomologist, Cedara School of Agriculture; transferred to Capetown.

28/5/25 *G. R. J. Bodde*, Inspector of Co-operative Societies; retired on pension.

/6/25 *L. J. Henning*, Itinerant Instructor in Tobacco and Cotton, Louis Trichardt; transferred to Rustenburg Tobacco and Cotton Experiment Station.

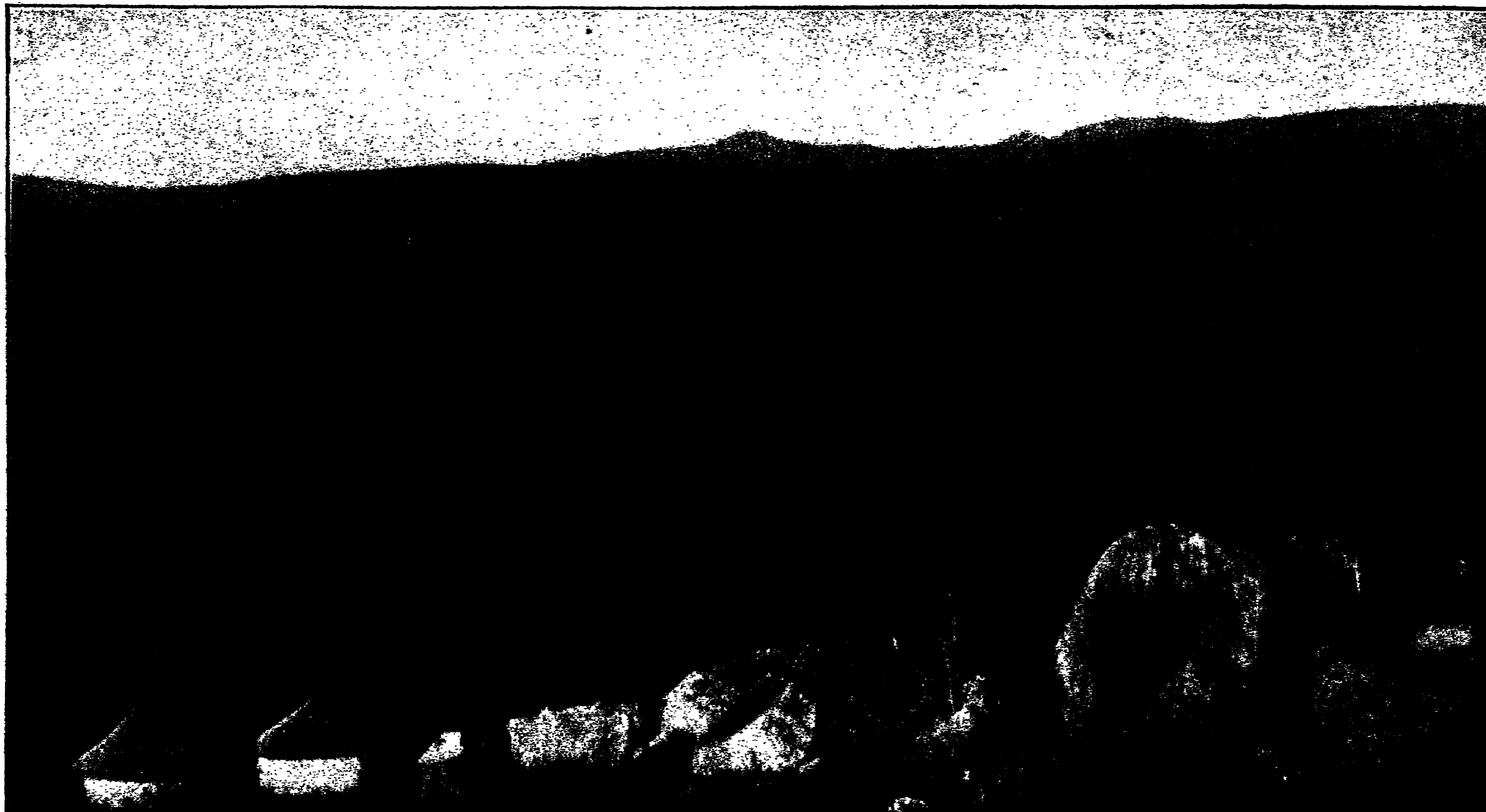
2/6/25 *F. E. A. Leibbrandt*, Technical Assistant, Soil Survey, Grootfontein School of Agriculture, Middelburg, Cape; transferred to Pretoria.

11/6/25 *Dr. St. C. O. Sinclair*, Acting Chief, Division of Chemistry, Capetown; transferred to Pretoria.

13/6/25 *A. Stead*, Senior Chemist in Charge of Soil Survey, Grootfontein School of Agriculture, Middelburg, Cape; transferred to Pretoria.

30/6/25 *A. M. la Grange*, Sheep and Wool Expert, Dordrecht, Cape; resigned.

1/7/25 *P. Koch*, Acting Chief, Tobacco and Cotton Division; transferred to Pretoria.



WHITE RIVER SETTLEMENTS, NEAR NELSPRUIT.

JOURNAL OF THE DEPARTMENT OF AGRICULTURE.

VOL. XI. SEPTEMBER, 1925. No. 3.

Published monthly in English and Afrikaans by the Department of Agriculture, Union of South Africa.

SUBSCRIPTION: Within the Union and South-West Africa, 5s. (otherwise 6s.) per annum, post free, payable in advance.
Applications, with subscriptions, to be sent to the Government Printer, Pretoria.

NOTES.

Compulsory Dipping, Cape Province.

The Minister of Agriculture makes the following announcement:

It will be remembered that in the beginning of this year my intention to order a compulsory dipping of all sheep throughout the country was made known. This was thought to be the best measure to attempt to eradicate scab once and for all time. Dipping accordingly took place in Natal, Transvaal, and certain districts in the Orange Free State, where scab was rife.

After careful consideration, it is found to be impossible in one season to dip under supervision all small stock throughout the Cape Province. The north-western portion of the Cape Province has always been an area where it is extremely difficult to combat scab owing to its vastness, and mainly because of the continuous droughts which occur there, which frequently reduce the stock to too poor a condition to dip, and trekking to other parts being resorted to as a means to keep the stock alive. That part of the country, however, has shared this year in the abundant rains which have fallen over nearly the whole Union and have now afforded us an opportunity to dip the sheep in the north-western Cape which may, perhaps, not recur for many years.

To accomplish this work the whole available staff of the Department will be required.

It has, therefore, been decided to have general compulsory dipping of all sheep and goats in the Districts of Namaqualand, Van

Rhynsdorp, Calvinia, Kenhardt, Gordonia, Fraserburg, Williston, Sutherland, and Carnarvon. The dipping will be done under supervision of inspectors.

Some eighty extra inspectors will be required, who will be taken out of districts which are free of scab. The dipping will commence in September, and it is hoped to complete it by the end of November.

There are other districts in which a compulsory dipping is absolutely necessary, and, perhaps, if the dipping in the above-mentioned districts is finished in time, it may be possible to undertake dipping in some further districts, where it can be done at a later date.

Furthermore, in all other districts in the Cape Province, those flocks which have been infected within twelve months, or in contact with infested flocks within six months, from date of publication of the compulsory dipping order to be published in the *Government Gazette*, will be dipped.

Once more I appeal with confidence to all farmers' associations and sheep farmers for their hearty co-operation with the Department in its efforts towards scab eradication.

Wastage in our Local Marketing System.

One of the first steps of the recently created Division of Economics and Markets was to investigate the conditions prevailing at our principal local markets and the various systems of sale in vogue. That satisfactory marketing facilities are of the utmost importance to our farming industry is obvious, and that there is need for improvements in this respect is only too well known. The investigation was really a preliminary one; it will be followed up by closer inquiry. A report on this investigation has been prepared and will be published in due course; in the meantime it may be said that it shows the pressing need, at the outset, of finding the quickest and best way of removing the economic waste that at present results from our marketing system, having in mind that each product presents its own peculiar difficulties both in production and in sale.

Wastage of the product itself, of time, of money, and of effort generally are due to several causes, prominent among them being the following:—

(*a*) The waste that results from the unnecessary number of links in the chain of distribution; and from the great number of unnecessary chains that now link the producer and consumer, particularly where producers do not co-operate. The picture is too common of the individual farmer seeking alone for his market and then sending to it his own small quota of produce. Co-operative marketing would help to remove the overlapping and duplication that now so greatly reduce the farmer's return for his produce.

(*b*) The waste that results from marketing valueless and unsaleable produce; produce that in ordinary circumstances would create a demand were it only of better quality.

(c) The waste that results from the damage to perishable products due to lengthy transport and unnecessary handling.

(d) The waste that results from ignorantly sending produce to a market where no demand exists for it, or where it is being flooded with similar produce from other areas.

(e) The waste that results from the lack of facilities for the proper handling of consignments both en route and at destination.

(f) The waste that results from the artificial creation of a glut or a scarcity on any market for the purpose of encouraging speculation and fluctuations in prices.

(g) The great waste in the loss of capital invested in agricultural enterprise through produce failing to bring in a lucrative return, often a direct result of the glutting of the market at times when actually overproduction is insignificant. A little organization among farmers would remove this disability, which is the outcome of an ill-regulated supply of produce to the various markets in the Union. The effects of this unorganized condition were severely felt by farmers last year, many of whom were unable to secure returns sufficient to cover the interest on capital invested. Indeed, there were many instances of farmers having to pay a balance due for transport and other costs which were not even covered by the returns obtained for the produce.

(h) The waste that results from the high costs, affecting both producer and consumer, that are levied to cover the uncertainty and speculation surrounding our local marketing systems and induced by the several disabilities mentioned above.

The answer to the problem is found in the one word " organize." The co-operation of farmers in some parts of the world that has met with such marked success had its inception largely in an overwhelming desire to remove just such economic wastage as now saps the returns from produce marketed by our farmers. But whatever panacea may be suggested, as a foundation there must first be seen a livelier sense of trust among the farming community in the efficacy of organization and true brotherly co-operation. At the same time, the standardization and grading of all farm products must be introduced. And of outstanding importance, every effort must be made to bring about greater uniformity in our system of marketing generally, and particularly some relief from the many agencies and interests that now overburden it.

As already mentioned, the urgently needed improvement in this sphere of farming economics is one of the duties that is engaging the attention of the Department's Division of Economics and Markets. Its task is great, but with the will and effort of the farmer to improve his position it can be accomplished. And the good that will result, who can estimate?

Fruit for East Africa: Better Boxes Required.

There are considerable possibilities for the fruit trade in British East African Territories, more particularly in apples and the harder types of pears. This is the opinion of the Acting Trade Commissioner for the Union at Nairobi. At the same time he sounds the warning that insecure packing is likely to strangle this market at its birth. He has seen several consignments of fruit, particularly apples, from the Union, and in nearly every instance the boxes have arrived in a very dilapidated condition. Shippers must remember that the handling of fruit at East African ports is still very severe, and is in the hands of labourers little accustomed to that class of work, entailing as it does handling successively from ship to lighter, to shore, to warehouse, to railway, to distributor, to delivery van, and so finally to customer.

Having in view the many handlings that the boxes are subjected to and the conditions prevailing in those parts, the Acting Trade Commissioner advises shippers to use a stronger box with all corners clamped, and to secure two or more boxes together by stronger bands than is the present custom.

War with the Insect.

In his opening address at the recent Conference of Entomologists, referred to elsewhere in this number of the *Journal*, Mr. Lounsbury, the Chief of the Division of Entomology, made some impressive remarks. Referring to the band of competent entomologists that now serve the country, he pointed out the need of augmenting their number. It was not sufficiently recognized, he stated, that the gravity of insect pests was increasing at an enormous rate in South Africa and in some other lands, and that the increase of economic entomologists, great as it had been in recent years, was not keeping pace with the urgent need for their services. Advancing civilization, with its quick transport by sea, by land, and now through the air, was rapidly building up some terrific problems for the human race, and one of the most serious of them was that of insect pests. The fear that man may yet be conquered by insects is felt by not a few broadly informed economic entomologists. To prevent calamity to man in his ever-fiercer war with insects, it was necessary that more rapid progress than at present be made in devising means of offence and defence against the tiny foes, immensely formidable as they were owing to their rapid multiplication of individuals under the increasingly favourable conditions for them brought about by man's interference with the checks imposed by primitive nature. It followed that the official entomologists of the Union must be vigorously supported and encouraged by the Government powers in control, or man in this country will fight a losing war against its pests. While South Africa has made much progress in expanding its entomological force, it has not gone ahead as fast as some other countries where the need was no greater. Canada was instanced as an example.

Looking to the future and realizing how furiously was raging the war between man and insects, Mr. Lounsbury concluded his address in a strong appeal for further assistance in staff and facilities generally in carrying out the duty of his Division to suppress the enemy and so make agriculture economically possible in South Africa.

The Truth of Co-operation.

It is expected that when this note is published there will have been launched by the Department of Agriculture a campaign throughout the maize-growing area of the Union particularly, to induce farmers to realize how greatly their interests are served by combining. The need of co-operation has been preached for many years, so much so, indeed, that there is the danger of its being accepted as a truism—and then forgotten. It is not proposed here to give the many reasons why co-operation in the farming community is such a necessity. The reasons have been given over and over again. And as time goes on their truth becomes increasingly apparent; nor can isolated instances of failure in practice (through principle being neglected) and the arguments of those whose particular interests are better served by farming individualism, dim the truth that in co-operation lies the salvation of the farmer.

It is a truth that will be preached from many platforms during the next few weeks. The Minister of Agriculture sees in it the only way by which farming can progress; the Department of Agriculture cannot offer any other means of overcoming the economic difficulties that depress the prices obtained by the farmer for his products; and workers generally in the field of agricultural enterprise who have the true interests of the industry at heart, are convinced that only by co-operation can we make farming in South Africa the success it should be.

The campaign now in progress has the strongest support of the Department. Officers of the Divisions of Economics and Markets; Co-operation; and Extension; and also of the Land and Agricultural Bank, are engaged in preaching the truth of co-operation. With them are associated tried and leading workers in our agricultural life whose main object is to better the position of the farmer. All these will address meetings in the chief centres of the maize-belt.

Therefore, at this time, the Department sends this message to all farmers. Do not be misled by temporary gain or specious arguments. For your own sake and for the sake of the country that is dear to you, be master in your own house. Farmers can only be so by the sustaining power of true co-operation.

Wool Growers and Sellers.

Towards the close of May of this year a representative gathering of sheep-farmers and members of the wool trade, together with officials of the Department, met at Middelburg, Cape, for the purpose of discussing matters of great concern to all engaged in the sheep and wool industry of the country. The proceedings of this conference, including the full address of the chairman, Lieut-Col. G. N. Williams (Under-Secretary for Agriculture), the resolutions passed, and the discussions leading thereto, as well as certain reports submitted to the conference, have been published in a bulletin* issued by the Department. This publication will serve as a record of a most important meeting, out of which will grow, it is expected, much that will help to foster the industry and establish a healthy understanding between producer and seller.

* "Report of Proceedings of Wool Growers' Conference," Bulletin No. 5, 1925, obtainable from this office. Price 6d. prepaid.

"Eat More Fruit."

Reference is made elsewhere in this issue of the *Journal* to the spread of agricultural information by means of "news-letters." There is another movement that is being set on foot by the Department, in co-operation with the South African Railways and Harbours (Publicity Branch), and its appeal, in the first instance, is to the consuming public. It is a campaign to advertise and stimulate the greater use of certain of our products. The first to be dealt with will be fresh fruit. At present the grower, as a general rule, looks chiefly to the oversea market, and the one at his door receives secondary consideration. But the local market can be made a very valuable one; indeed, it is a vital necessity if commercial fruit-growing is to achieve full success. It is one of the objects of the campaign, therefore, to arouse interest in the fruit of our country, and by advertising its health-giving properties and many uses, to induce our public to eat more fruit. It is notorious that, in this world-famed fruit-growing country of ours, the consumption of fresh fruit is relatively small. Whether it be in town or country, there are large numbers of people who seldom eat fruit nor realize its superlative value in their daily diet.

A movement that will induce among South Africans a habit of fruit-eating may very well be termed a national one, for it will benefit both an important industry (the success of which will add greatly to the material progress of the Union) and the health of the people, stimulating their productive energy, and so contributing to the good that such a condition would engender.

As a first step of the campaign, it is proposed to display, as widely as means will permit, a very attractive poster that will hold the attention of all who see it. It will instantly visualize the fruitfulness of South Africa, and the message it will bring in its slogan, "Eat More Fruit," should create in the mind the desire to use more freely the gift that nature has so generously given to our land of sunshine.

This poster will signal the commencement of the movement. Advertisement and propaganda of this nature are costly, and the fund available for the purpose is, unfortunately, small. But the public will need to be kept interested by means of further posters at seasonal periods, showing, for instance, the uses to which particular fruits can be put, as well as by other devices designed to encourage a fruit-eating habit in town and country dweller alike.

Strong as it is desired to make the appeal to the consumer, there is also the equally strong need for propaganda among producers. It is they who must grow and pack a standard of fruit that will be acceptable to the consumer. Far transcending the worth of any poster will be the advertising value of fruit attractively graded and packed. Moreover, there is yet a third need, and one equally as necessary as the production of the article and the desire to eat it. It is the rapid rail transport and distribution generally of the fruit, so that it will be available in regular supply to all classes of the public and at a price that will enable the humblest to procure his portion of sound fruit. In this respect, it may be mentioned that at the various municipal markets steps are to be taken which will bring the producer and consumer into direct contact for purposes of trade, and eliminate unnecessary handling by the middleman.

Here are three problems that will employ the thoughts of those endeavouring to widen our local market for fresh fruit. A similar campaign introduced into the British Isles some time ago has met with success. There is every reason to expect that in South Africa also a well-organized system of distribution of an acceptable article to an interested consumer will meet with similar success. A beginning has been made. In view of the magnitude of the task, it must necessarily appear a humble one. But it is a step in the right direction, and its pace will accelerate with experience and a strengthening of the present slender resources. And once started it must be continued until the goal is unmistakably reached. In the course of time other products will be included in the campaign. There is the instance of fresh milk, the greater use of which needs to be stimulated: the national good that would follow a more liberal use of milk in the home would equal, at least, the benefits that the introduction of fresh fruit into the daily diet would bring.

At the outset—as it is with so many things that determine the welfare of our country—it is the farmer that is really most concerned, for no effort to widen the market for fruit can be effective unless it is backed by the production of an acceptable article. And many of our farmers have still to learn that the surest way of selling a product is to please the eye. Send the consumer attractively packed, sound fruit and he will most assuredly "Eat More Fruit."

Hides and Skins for America.

Arrangements have been made for the importation into the United States of America, without requiring disinfection after arrival, of abattoir hides and skins from the Union of South Africa. The provisions of section 1 (*d*), Regulation 5 of B.A. 1 Order 286 of the Government of the United States of America, apply, and such hides and skins must be accompanied by a veterinary certificate from the municipal abattoirs at Johannesburg, Capetown, Durban, or Bloemfontein, given by the officials named below, on form No. 260, Consular. Certificates will also be accepted from these officials, on form No. 261 covering pulled wool, hair, and bristles taken from animals slaughtered under inspection at the abattoirs mentioned above, and also on form No. 263 covering abattoir glue stock.

These forms (260, 261, and 263) may be obtained from any American Consular Office in South Africa.

The following are the officials eligible to issue certificates at the abattoirs mentioned:—

Johannesburg	J. Irvine Smith.
	A. C. Kirkpatrick.
Capetown	J. Forrest.
	A. F. G. Smith.
Durban	W. G. Barnes.
	E. le Guci.
Bloemfontein	N. M. Clayton.

Any hides or skins arriving in the United States of America from the Union without the required certificate will be required to be disinfected there at owner's expense.

Cotton Research Station for the British Empire.

A decision of great interest to cotton-growers in South Africa and other parts of the British Empire has recently been made by the Empire Cotton Growing Corporation. It is to establish a Central Cotton Research Station in Trinidad, where it is intended (according to a report issued by the Corporation) to investigate the cotton plant in all phases of its growth and under rigorously controlled conditions, so that it may be possible to ascertain and to estimate the importance of the several factors which contribute to the final result. There are many fundamental problems connected with the cotton plant and with the properties of its lint, the investigation of which does not fall within the duties of the scientific specialists on the Agricultural Staff of any single cotton-growing country, and who, indeed, have not the time to devote thereto. But the successful solution of such problems should certainly lead to results of the highest value to the cotton industry, and it is with this in view that the Research Station at Trinidad has been decided upon, whose chief function will be the special study of such problems. For example, it will study the mechanism of the growth and behaviour of the cotton plant, its reaction to its environment, and of the connexion between the characteristics of the lint and its spinning qualities.

The Station will not be used for the investigation of local difficulties which in most instances can better be studied in the country in which they originate. Nor is it intended to provide strains of pure-line seed for large-scale distribution to the cotton fields in different parts of the Empire. The effect of the acclimatization factor on the properties of any particular type of cotton renders it essential that the production of seed for this purpose must be carried out in the country concerned, and the utmost the Station can do in this direction is to breed out pure lines for special characteristics. Such seed sent, for instance, to the Union would have to be tested here as to suitability, and, if successful, serve as a starting point for the raising of new strains of cotton which might be more suitable than those bred at present.

The Station, it is hoped, will be used by cotton-workers as a central clearing house at which local problems can be further investigated under standardized conditions. It will suggest where and how any particular problem should be attacked with the greatest prospect of success, and thus be of great assistance to all cotton research workers.

It is emphasized, however, that the establishment of this Station will in no way relieve Departments of Agriculture of the necessity of continuing the scientific side of their research work on cotton, for local problems can mostly best be solved locally. It is no less necessary for us to strengthen our local position by devoting all our energy and available resources in tackling the various difficulties that are likely to retard our progress as a cotton-producing country. At this critical time when cotton growing in South Africa is on the eve, indeed has commenced, an era of rapid expansion, and when initial difficulties are bound to arise, whether agricultural or economic, the decision of the Empire Cotton Growing Corporation to establish a central Research Station, which marks a new departure in the work and activities of this body, comes as an encouraging reminder of the important interests that are

vitally concerned in making cotton growing a success, and that are therefore doing everything possible to assist to a successful issue the enterprise of cotton-growers in South Africa.

Spreading Agricultural Information.

Mention was made in the *Journal* some months ago of the intention of the Department to augment, by the issue of a weekly "news-letter" or advice-sheet, its means of getting in touch with farmers. The first of these advices was issued on the 27th July, 1925, and it is intended to publish them regularly every week thereafter. They will give clear, concise information on matters that every farmer should know, each advice being confined to one subject, so that in the course of time a collection of these leaflets should form a valuable handbook of agricultural intelligence for South Africa.

All officers of the Department who come in direct touch with farmers will receive copies of these advices and they will make a practice of imparting the information they contain to as many farmers as possible. But wider publicity will be given them. Copies will go to the South African Press, whose co-operation in publishing them will be a most valuable aid in sending the advice to the remotest farmer. Post offices throughout the country will display these "news-letters," so that visiting farmers may read them, while at every magistrate's office a copy will be on view. Perhaps the greatest good from this service of agricultural intelligence may be expected from the distribution of the leaflet among all school teachers in rural areas, who will doubtless make use of them for instructional purposes and so, through the pupil, reach the farmer.

Nor do these means exhaust the available channels of spreading this farming advice. There are other ways of reaching the people most concerned, so that in the course of time there should be no person engaged in farming who does not have the opportunity of benefiting by the teaching broadcasted by the Department. And that educative work of this kind is necessary goes without saying. There are still, unfortunately, large numbers of farmers who are not easily reached by the Department's *Journal* and other printed matter, or who are not sufficiently interested to read them with care. It is hoped that the "news-letter" with its brief, weekly message will, at any rate, reach every farmer. But farmers should not be content with this form only of learning how to ply their industry. With farming, as with other enterprise, "get on or get out" becomes increasingly imperative. The Department spends large sums of money in the furtherance of its great duty to foster agricultural production. It has earnest and able officers spending their whole time and energy to this end. It is to make known the results of the labours of this great State organization that the Department publishes its monthly *Journal* and bulletins on specific subjects. No farmer, therefore, who desires to progress and to make a success of his farming should be negligent in acquainting himself with the pronouncements, made from time to time, of the Department, whose sole interest is to bring prosperity to the country's agricultural industry—the greatest asset of South Africa.

DEPARTMENTAL ACTIVITIES.

(NOTE.—The work of the several Divisions and Schools of Agriculture covers a wide range of agricultural industry in the Union, and we give hereunder notes and observations from certain of them treating with matters of special interest coming under their purview month by month. The object of these notes, which are not concerned with general routine work, is to inform the farmer of such matters as are calculated to be of interest and helpful to him.—EDITOR.)

THE DIVISIONS.

TOBACCO AND COTTON.

Progress of Cotton.—During the month of July the cotton crop moved very freely, and many auction sales were held in Durban, the prices realized being fairly satisfactory, although showing a slight decline in basis. There has been a sad lack of competition amongst the local buyers.

American crop reports are none too favourable; rain is badly needed in Texas, and many reports of boll-weevil activities come from the eastern belt. The estimates for the coming crop from the United States of America are 14 to 14½ million bales.

In Liverpool a new delivery contract for Empire and miscellaneous cotton has now been adopted, and will have force from 1st September, 1925, for delivery of cotton in October, 1925, and onwards. Trading will be in multiples of 50 bales (containing 24,000 lb. cotton), the cotton to be at least equal in value to the universal standard for strict low middling American cotton, but not below the grade of that standard and of not less than fair staple; or, if tinged or stained, or any grade which (irrespective of allowance to seller for staple) is at least equal in value to the said strict low middling standard (equal in colour to the standard and of not less than fair staple).

The price will be in pence per lb., for middling American cotton (universal standard). Each tender on this contract must be cotton grown in the same country.

ENTOMOLOGY.

A New White Ant.—A rather unique record of white ant mischief reaches the Division from Simonstown. Notwithstanding the many different sorts inhabiting the Cape Province, there are none, as regards the major and southern area, that regularly injure the woodwork of houses. Specimens of white ants guilty of such damage were, however, submitted to the Division in June last by the Town Clerk of Simonstown. These prove to belong to the genus *Coptotermes*. Hitherto no *Coptotermes* have been found in South Africa, and only two or three species have been reported from Africa, as a whole. These species are found as far off as Senegal, French Guinea, the Gold Coast, Nigeria, and the Cameroons. This adds to the interest of the discovery. It appears that, so far, very little is known of the habits of *Coptotermes* in Africa.

The Sombre Twig Pruner.—This insect (*Thercoclades kraussi*) formed the subject of a rather lengthy notice in the *South African Agricultural Journal*, February, 1913. About that time it had been found abundant and very destructive to privet hedges in Pietermaritzburg, Natal. Since then, however, the insect had not come to the notice of the Division of Entomology until July of this year, when it was found infesting a privet hedge in Church Street East, Pretoria. This infestation must be two or three seasons old, but the injury has only lately been sufficient to draw attention to it. This twig pruner is known to pass its earlier life-stages in wild and cultivated olives, as well as in the privet, but does not appear to be commonly a nuisance. It is quite possible, however, that it will become as troublesome in Pretoria, where privet trees and hedges are numerous, as it was in Pietermaritzburg. The beetle has formerly been reported from the following localities: Angolaland, Southern Rhodesia (Tegweni, near Plumtree), Transvaal (Waterberg, Zoutpansberg), Natal (Amajuba, Pietermaritzburg, Bellair, Durban), Cape Province (Fort Cunningham, Tokai).

Conference of Union Entomologists.—The 1925 Annual Conference of official Entomologists was held in the Conference-room, Union Buildings, on 27th to 30th July. There was a full attendance of entomologists from the five Department Schools of Agriculture and from all sections of the Division of Entomology (twenty-four officers in all), and there also attended by special request Mr. R. W. Jack, the Chief Entomologist for Southern Rhodesia; Mr. C. B. Hardenburg, the Chief Entomologist for Portuguese East Africa; Mr. A. H. Bedford, the Entomologist of the Division of Veterinary Education and Research; Dr. A. Ingram, the Entomologist of the Institute of Medical Research (Johannesburg); Dr. C. K. Brain, the Professor of Entomology of the University of Stellenbosch; Mr. J. C. Faure, the Professor of Entomology of the Transvaal University College; and Dr. A. J. T. Janse, of the Normal College, Pretoria. Dr. Janse, it may well be explained, is a systematic entomologist of world-wide repute, who for years has been exceedingly helpful to the Government entomologists of South Africa in the identification of moths.

The conference was opened by General Kemp, the Minister for Agriculture. Mr. C. P. Lounsbury, Chief of the Division of Entomology, occupied the chair.

The annual conference serves several important objects, the chief of which is to stimulate mutual helpfulness along the lines of the many investigations in progress. Each of the officers has one or more special subjects for inquiry and investigation, and in a general way each one is able to help all the others in his particular line, and yet may himself get much aid in that line in a round-table discussion with entomologists who work in different parts of the country. At the conference nearly every officer read a paper or gave a talk on a subject on which he had been engaged for much of the year, and the diversity of the subjects discussed illustrated the wide field of entomological inquiry having the attention of the Department. The subjects included cotton pests, white ants, tsetse fly, citrus thrips, blemishes on oranges, recent development in apiculture, tree-fumigation problems, fruit-flies, jassids, aphides, plant mites, sheep blow-flies, codling-moth in apricots, eucalyptus snout-beetle, sweet-potato weevil, and granary insects in elevators. It is expected that some of the papers will be published.

THE SCHOOLS OF AGRICULTURE AND EXPERIMENT STATIONS.

GROOTFONTEIN, MIDDELBURG (CAPE).

Karroo Bush Seed.—Other countries with semi-arid areas are becoming aware of the fact that the Karroo possesses very valuable stock bushes which are remarkable in their resistance to the effects of drought and to heavy grazing, and many requests for seed for trial purposes have recently been received. The ordinary "skaapbos" appears to be the best known, and is always asked for in particular. Packages of seed varying from half a pound to three pounds in weight have been sent to five different addresses in Australia, as well as to New Zealand, U.S.A., and Central America. If these preliminary trials prove successful, a demand will no doubt be created for more seed, resulting in a profitable little side-line for the Karroo farmer.

Bars in Ostrich Feathers.—Since the beginning of March, 1924, investigations have been carried out at Grootfontein to determine whether great variation in temperature is a factor which might cause bars in ostrich feathers. For the purpose twelve birds, six cocks and six hens, of the same age and of more or less even growth of feather, were selected. These birds were camped off and fed daily on a ration consisting of lucerne-hay, prickly pear, and mealies. They received the same daily ration throughout the course of the investigation.

A week after the investigation started the birds were brought into a kraal and the feathers of the first row on each wing were measured, after the tips of the feathers had been clipped off to ensure greater accuracy in measuring. Measurements were thereafter taken on alternate days.

In September the feathers were clipped, great care being taken to mark them according to their position on the wing. The feathers were then measured back from the tip to each bar, and from these measurements it was possible to ascertain on what particular day the bar occurred. Graphs for each wing were then prepared from these data. These graphs showed the number daily of bars occurring throughout the wing.

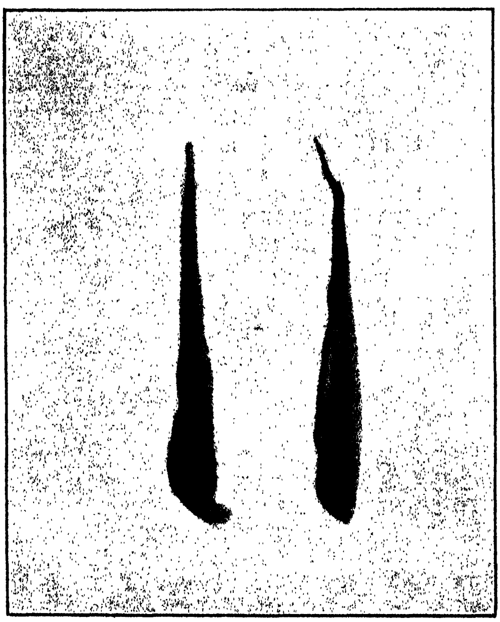
Meteorological data were obtained from the Grootfontein Meteorological Station, and corresponding graphs were also prepared therefrom.

According to these graphs, it was clear that considerably more bars occurred at the beginning of this experiment, gradually becoming less numerous as the feather growth increased. This may possibly be due to the birds becoming accustomed eventually to the frequent handling or more acclimatized to the winter conditions.

Although considerable information has been obtained, it is impossible to make any definite statement yet as to whether great variations in temperature affect the growth of the feather until these outside influences have been eliminated, and with that end in view these investigations are being continued.

The Parasite "Linguatula taenioides."—The linguatules are very interesting parasites. They are not too well known and might easily be mistaken for tapeworms. Although these parasites resemble tapeworms very much superficially, they are actually very far removed from each other and show no affinities. The linguatules have undergone a great deal of modification on account of their permanent endoparasitic mode of life. The tapeworm belongs to the group of flatworms or Platyhelminthes, and the linguatules to the Arachnida, to which group belong the ticks, spiders, scorpions, etc.

Some little time ago two specimens were sent to Grootfontein from a farmer in the Fort Beaufort District, who said that they were sneezed out by a dog. The specimens were of particular interest as they are by no means common.



Linguatula taenioides.

It will be seen from the accompanying illustration that the parasite resembles a tapeworm, but, if compared, the difference will at once be seen. The specimens shown are endoparasitic arachnida, with a long vermiform and segmented body. The mouth is destitute of jaws in the adult and surrounded by two pairs of hooks representing legs. Respiration is cutaneous.

The adult linguatules, both males and females, occur in the nasal cavities of the dog. Both specimens shown in the illustration are females, and are about 7½ cm. long. The males are much smaller, and are about 18 mm. long. The ova are deposited in the cavities, and are expelled to the exterior with mucus when sneezing. If these fall on grass or forage they are retained there. The mucus protects the eggs for several weeks. If the grass on which eggs occur is eaten by any herbivorous animal—sheep, goat, etc.—the embryos are released in the intestines of the new host.

The resulting embryo resembles the arachnida to some extent. This larva is the phase in the life-history which gives us a clue as to the position of this parasite in the natural classification of animals.

The little larva then bores through the digestive canal and reaches the organ, where it is to be encysted—mesenteric glands, liver, lungs, etc.

After arriving at its first position, it loses rostrum and legs and becomes a resting pupa. Afterwards the pupa transforms into a secondary larva, which is well supplied with hooks. These mature larvae then migrate all over the body. Some fall into the peritoneal cavity, where they might die if not taken in by a dog. Others penetrate to other organs, as, for example, the lungs, from where they might be sneezed up and picked up by a dog. Probably the dog picks up most of these mature larvae through eating organs of herbivora in which these larvae are encysted. Then in some way they make their way to the nasal cavities, where the larva transforms into the adult, which, after some time, deposits eggs to be sneezed out and again infest other herbivora. It has been estimated that one female can deposit as many as 500,000 eggs.

In short, it may be stated that the evolution of the parasite occurs in four distinct stages:—(1) Acariform embryo, (2) encysted nymph, (3) free or encysted larva, (4) adult parasites in nasal cavities.

The parasite does not occur frequently. Probably it occurs more frequently in sheep, and dogs kept by butchers. The adult linguatules have even been found in human beings.

The parasite causes very little ill-effect on the dog except sneezing and a little irritation.

The preventive treatment consists in keeping dogs away from the entrails of sheep which may contain the linguatules, but, what is of greater importance, the entrails may contain the bladder-worms of tapeworms, of which the dog is the host.

GLEN, ORANGE FREE STATE.

Utilize the Farm Manure.—Nearly all farmers make use of stable and kraal manure—some in the correct, others in the wrong, way. "Utilize" in this respect should mean "return to the soil," and not, for instance, "use for fuel." The manure originally comes from the soil (from veld grass, etc.), and if we do not wish to ruin the soil—if we wish to maintain the humus-content and consequently the fertility of the soil, then all animal faeces should be returned to the soil. Instead of burning the heap of faeces, bury it, plant a tree on it, and later burn the tree. The manure is capital; the tree is interest on the capital. A farmer living on his capital is on the down-grade. Our farmers, especially those in the maize-producing sections, should pay more attention to the matter of forestry. Firewood is still so scarce on some farms that the natives collect all the manure from the veld for the purpose of making a fire. The native, therefore, also lives from the "capital" of the farm! Rather see to it that he has "interest" to make use of. Utilize the capital for the improvement of the crop-yield.

A Successful Soiling Crop.—The success of swiss chard under irrigation this year is worthy of note. The plants have grown 2 to 3 feet high, with an estimated yield of about four tons.

Chard, leaf beet, perpetual beet, silver beet, or kale beet as it is variously known, is a biennial of the beet family grown for its large leaves and broad thick petioles. The roots are small and woody. The seed is sown in the spring, as with common beet, and the crop can be harvested from about the middle of summer onwards. In a good season three cuttings may be obtained. As the plants stand frost well it may serve as a succulent for winter use; however, growth practically ceases then. It is essentially a soiling crop, for the plants are seriously damaged by pasturing and are too succulent for silage purposes. The feed is greatly relished by the pigs and cattle to which it is fed here.

The Continuous Use of Superphosphates.—The assertion on the part of some farmers that the continuous use of superphosphates exhausts the soil, although justifiable to a certain extent, is based on a false conception of affairs and needs explanation.

It is now a well-established fact that in nearly all our soils there is a deficiency of phosphorus (or phosphate or phosphoric oxide), which is an essential constituent of plant-food in the soil. Superphosphate provides this necessary element in an available form for the plant. It is thus reasonable to assume that the use of phosphatic fertilizer enriches the soil. And experience has fully demonstrated that superphosphates (and also other phosphatic fertilizers) greatly increase crop production. The assertion quoted above must thus be considered an unjustifiable indictment against superphosphates. It is, however, not altogether unfounded. Superphosphate (and fertilizers in general) is primarily and mostly used for very poor soil, i.e. for soil in which there is not only a deficiency of phosphorus, but in a less degree of nitrogen and probably potash, and also other soil essentials such as humus and lime. The application of phosphate, to supply the primary and greatest deficiency, results in such an excessive increase in the production of crops, that the other necessary soil elements become exhausted, particularly as superphosphates in some soils assists in making more available these other necessary plant-foods. In such event it cannot be said that *superphosphate* exhausts the soil, but rather the *increased yield*. To persist in obtaining large crops from poor soil requires a regular return of everything that is taken out, in the proportion required by the soil. In some instances farm or green manure, in addition to superphosphate, would make good the deficiency. In others, it would be necessary to use fertilizer containing nitrogen and potash, or even lime.

Because superphosphate is acid, it tends to increase the acidity of acid soil. Soil acidity, however, will not quickly affect such crops as wheat, maize, and potatoes. Nevertheless, a continuous addition to the acidity of the soil may become in time detrimental to its productivity. In this way an indiscriminate use of superphosphate may lead to an ultimate deterioration of the soil. But until there is further proof of this, farmers (in the Orange Free State at any rate) are recommended not to have any hesitation in using superphosphate for potato and wheat crops.

Fertilizers and Drought.—The experience of some farmers that "the fertilized crop is the first to suffer from drought," while probably correct in many instances, is not generally applicable.

Two main facts to consider are:—(1) The correctly fertilized crop will tend to produce better growth than the unfertilized crop on the same soil; and the more growth the greater are the water requirements of the plant. (2) The plant obtains all its food *in solution* from the soil; hence, the poorer the soil is in available (i.e. soluble) plant-food the more water (soil solution) would have to be drawn from the soil by the plant in order to get the required nourishment.

While (1) corroborates the above-stated experience, (2) indirectly contradicts it. The net result depends on various circumstances, which, practically speaking, can be summarized as follows:—

If the depth of distribution of the fertilizer is slight (say, as in the ordinary case of fertilizing maize by means of a "fertilizer attachment"), and drought catches the crop in its early stage (in the same season when the fertilizer was applied), the crop will suffer more severely than its unfertilized neighbour. This would apply especially when the fertilizer used was such that it stimulated growth. On the other hand, if the soil in question had been well fertilized the *previous* year, say, as for potatoes, the maize crop which follows the potatoes would stand the drought better than its unfertilized neighbour. This is not only in accordance with theory, but is the experience of farmers in this Province. It is also an argument for the *systematic* use of fertilizers, i.e. in a proper system of *crop rotation*.

It is hardly necessary to refer to the fact that no fertilizer can combat a severe drought nor an excess of rain. Fertilizers supply *plant-food*. If seasonal conditions are such that the *water* requirements of the crop are abnormally exceeded or hopelessly deficient in the soil, no addition of plant-food, i.e. fertilizer, would prevent a crop failure.

The Manufacture of Cream Cheese.—Cream cheese really applies to cheese made entirely from cream, although the term is often used when the article is made either from milk or milk which has been enriched by the addition of cream.

To produce the characteristic flavour of cream cheese, strict cleanliness must be observed in the production of the milk and all utensils must be clean. The use of dirty milk and utensils will produce "off flavours" in the finished cheese, which will deteriorate rapidly.

Cream cheese may be made either with or without the addition of rennet.

Method of Manufacture with the aid of Rennet.—Set the cream-screw of the separator to take off a cream varying between 25 to 30 per cent. butter-fat; place the cream in an enamelled bucket or basin and cool to 60° F. (regulate the temperature to a slightly higher degree in winter). Add eighteen to twenty drops of rennet extract to each quart of cream. Before adding, the rennet should be diluted with a little clean cold water in order to enable it to become thoroughly distributed. Mix the rennet thoroughly in the cream for at least six to seven minutes, and then cover the bucket with a cloth to prevent the entry of dust particles.

Let the cream stand from fifteen to eighteen hours to allow it to coagulate or thicken. When thick, the cream should be carefully

ladled out by means of a sterile ladle or spoon into well-scalded huckaback cloths, not more than a gallon of cream being placed in each cloth.

Tie each cloth up as though it were a bag, taking care not to tie too close to the cream, since this would result in fat being lost in the whey or water draining from the cloth. Hang the cloths to drain in a good draught in a pure atmosphere. Open the cloths every three hours and, with a knife, scrape the hardened cream from the outsides into the softer cream in the centre. After the second scraping fresh cloths should be used.

Flatten the cheese out when in a pasty condition and salt to taste; fine butter salt only should be used, and should be thoroughly mixed into the cheese. Mould the cheese into square, oblong, or round form; the last is the correct shape.

The correct size of the mould is three inches in diameter by one and three quarter inches deep. The moulds can be cut from baking-powder or other similar tins, and should be lined with either grease-proof paper or butter muslin, into which the cheese is filled.

Fold the wrapper over the cheese when the mould is full and apply slight pressure by means of a weight. The finished cheese can be given an attractive appearance by wrapping in tin-foil.

Rennetted cream cheese should be made in summer, since drainage is quicker, which means a sweeter cheese. Usually a greater weight of cheese is obtained when rennet is used.

Method of Manufacture without Rennet.—Take thick cream off the separator, consistency 60 per cent. butter-fat, cool to 60° F., place in a clean huckaback cloth, and hang to drain. The process is identical with that described above, with the one exception that no rennet is added.

The drainage is much slower in this method. To avoid a sour flavour open the cloths and scrape cheese more frequently. When the cheese has a tendency to become pasty place it—in the cloths—between two boards and apply slight pressure by means of weights.

CEDARA, NATAL.

A Spray Programme for Natal.—The spraying season has commenced. Growers will be spraying their orchard trees to protect them from various insect pests and fungous diseases. The following programme is arranged to control the more troublesome insect pests and plant diseases, but incidentally it controls some also of less importance.

(1) *Apples and Pears.*

First Application.—When the trees are dormant about mid-winter, spray with Capex or Champion lime-sulphur solution at the rate of 1 gallon to 9 gallons of water, for use against San José and the lesser scale insects, black spot and scab. If no scale is present, delay this spray until the buds are about to burst. Dilute the lime-sulphur to one in twenty-five.

Second Application.—When the buds show a pink colour, but before the petals unfold, spray with lime-sulphur (Capex or Champion), 1 gallon in 40 gallons of water, or bordeaux mixture made up of 4 lb. quicklime, 4 lb. copper sulphate, and 50 gallons of water. This spray is an important application in controlling scab.

Third Application.—When about two-thirds of the petals of the blossoms have fallen, spray with Capex or Champion lime-sulphur, 1 gallon in 60 gallons of water, or bordeaux mixture (4:4:50). If codling-moth abounds in the district, add 1½ lb. arsenate of lead powder, mixed into a smooth paste, to each 50 gallons of the above spraying mixture. Take every care to fill up the flower-cups. This is a very important spray in controlling codling-moth.

Fourth Application.—About two weeks after No. 3, spray with bordeaux mixture (4:4:50) for preference, or Capex or Champion lime-sulphur, 1 gallon in 100 gallons of water, choosing cool days and evenings for application to avoid injury to the foliage.

Fifth Application.—Between the fourth and sixth week after No. 3, for codling-moth only, using 1½ lb. arsenate of lead powder to 50 gallons of water. Repeat again about ninth or tenth week after No. 3.

In very wet districts, and where fungous diseases are bad, further applications of fungicide may be necessary at intervals of thirty days to keep pace with the unfolding of the leaves, and so protect them with spray.

(2) *Stone Fruits: Peaches, Plums, etc.*

First Application.—Just before the buds burst, Capex or Champion lime-sulphur solution, 1 gallon in 9 gallons of water; for use against scale insects and as a preventive of curly leaf, freckle, brown rot. If black peach aphis be present, add 1 gallon of McDougall's Lion Brand tobacco extract to each 100 gallons of the above spray mixture.

Second Application.—After the bloom has fallen and the shucks on the young fruits are shedding, spray with bordeaux mixture (3:3:60) against peach freckle and brown rot. Stone fruits are very susceptible to spray injury through the use of concentrated lime-sulphur (when trees are in foliage), even when diluted to 1 in 100.

Third Application.—At intervals of 30 days or less until all the leaves have expanded and shoot-growth has finished for the season, spray with bordeaux mixture (3:3:60) or what is known as "self-boiled" lime-sulphur (8:8:50).

(3) *Special Sprays.*

Woolly Aphis on Apple Trees.—Use 1 gallon of McDougall's Lion Brand tobacco extract, plus 1 gallon of Capex or Champion lime-sulphur, in 200 gallons of water. Spray with considerable force to dislodge the woolly covering. If possible, spray when the sun is off the trees when using lime-sulphur, as it has a tendency to burn the foliage.

Black Peach Aphis.—Spray with McDougall's Lion Brand tobacco extract, 1 gallon in 80 to 100 gallons of water, in which a large handful of soft soap has been dissolved.

Leaf-eating Insects.—Spray with arsenate of lead powder at the rate of 1½ lb. of powder to 50 gallons of water.

Fruit-fly.—Use Mally fruit-fly bait every ten days and after rain. Commence when the fruit is about half-grown. Made as follows: 1½ ounce of arsenate of lead powder, 3 lb. cheapest sugar, one paraffin tin water. Use one garden syringeful to the average sized large tree. Allow it to fall all over the tree in rather large drops.

POTCHEFSTROOM, TRANSVAAL.

Fertilizers.—The use of fertilizers in the Transvaal has increased from 6,000 to 30,000 tons in three years. This is indication enough that at last, after years of preaching, the farmer is beginning to realize that fertilizers are an absolute necessity for economical crop production on most soils. The chief needs of South African soils are phosphates and organic matter. For the first deficiency superphosphate usually gives the best returns, and the cheapest way of buying it is (17.1 per cent. water soluble) at £4. 10s. per ton. This is the current price with a number of firms, and farmers should not pay more, f.o.r. coast ports. Railage costs are 1s. to 19s. per ton. For use in fertilizer attachments, super usually wants mixing with some other ingredients, as it is hygroscopic, i.e. it takes up water and is apt to become somewhat sticky in the bin and give trouble in running through. To overcome this, it can be mixed with (1) clean sand, (2) dry sifted kraal manure in various proportions, (3) 5 per cent. carbonate of lime or wood-ash, and (4) one-tenth to one-half part rock phosphate or bone-meal.

These mixtures at the rate of 400 lb. per morgen for dry-land crops and 800 lb. per morgen for crops under irrigation generally give satisfactory results. On irrigated soil, a good dressing of animal manure will give bigger increases. On dry lands, animal manure must be applied in quantities of 2 to 4 tons per morgen. If no animal or green manure is available, on some soils it will be necessary to add nitrogen to the super mixture. It can be done by using half super and half bone, or by adding 20 to 30 lb. ammonium sulphate to every 200 lb. super. On some soils for certain crops, potash in addition may be necessary. The need for this substance should be tested by every farmer as very often it does not pay. This advice applies also to lime; there are many crops, such as maize and cow-peas, that grow quite well on soils containing little lime. Not phosphates alone, but these other most necessary substances, together with a crop rotation including a legume which is fed off on the land or ploughed under, will maintain the average soil in a good fertility. If kraal manure is available, the ploughing under of legumes is not necessary.

Rural Electrification in South Africa.—An inquiry has been received as to the prospects of rural electrification in South Africa. As things are, and at the present stage of settlement in South Africa, about the only set of circumstances that allow of the installation of electric power on the farm is the presence on the farm of a suitable supply of water and sufficient fall occurring within a reasonable distance along the course of the stream.

It is interesting to learn that a Committee investigating the subject of the supply of electricity by power companies to farms in the United States of America has in its possession a report on thirty-two lines. This report shows that not one of these thirty-two lines is a paying investment. The Committee considers that the solution of the rural electrification problem lies in showing the farmer how to use a considerable quantity of electricity to his own advantage.

With regard to the question of how much power is required for different purposes, the following list is of use:—

For all the lighting of the average farm-house, yard, and barns: 25 kilowatt hours.
To run the cream separator for a month: 5 to 6 kilowatt hours.
To pump the water for house and barns: 25 kilowatt hours.
To run the kitchen range: 100 kilowatt hours.
To run the washing-machine: 5 kilowatt hours.
To do the family ironing: 16 kilowatt hours.
To run a 3-h.p. feed-grinder an hour a day: 16 kilowatt hours.

It would be safe to say that 200 kilowatt hours would perform all these tasks for a month on the average farm.

Short Courses of Instruction, 1925.—A short course on citriculture, tobacco, and cotton was conducted at Nelspruit from the 15th to 19th June, 1925; the attendance was 52 men, 4 women, and 27 diploma students, a total of 83, of which 94 per cent. were farmers, agricultural students, or settlers.

Short courses were held at this Institution in June and July as follows:—

First Course.—Poultry, horticulture, economic entomology, apiculture, and agricultural botany.

Second Course.—Dairy cattle, dairying, and pigs.

Third Course.—Field crops and beef cattle.

First Domestic Science Course.—Cookery.

Second Domestic Science Course.—Dressmaking.

The number and occupations of those attending these courses were as follows:—

Occupation	1st Course.	2nd Course.	3rd Course.	1st D.Sc. Course.	2nd D.Sc Course.	Total.
Teachers	27	9	1	8	5	50
Agric. students ..	14	14	14	—		42
Farmers	11	9	6		—	26
Farmers' wives ...	5	2	—	3	2	12
Farmers' daughters	3	—	—	6	3	12
Students	1	1	1	2	—	5
Settlers	1	1	1	—	—	3
Retired	1	—	—		—	1
Doctors	1	1	1	—	—	3
Matrons	1	1	1			3
Others	1	1		1	4	7
	66	39	25	20	14	164

It is proposed to hold courses during the coming year as follows: 4th to 8th January, sheep and wool; 11th to 15th January, field crops and beef cattle; 12th to 15th January, home economics, canning of fruit and vegetables, and jam-making.

During the winter, poultry, horticulture, apiculture, dairy cattle, dairying, pigs, and home economics courses will be held.

THE GREAT DROUGHT PROBLEM OF SOUTH AFRICA.

III.

The Warning of the Midlands.

ALTHOUGH aware of the evil in our midst and having seen its dire effect in the great gulleys that gape their story over stretching miles of country, it may be that there are many people who carelessly think that their generation is at least secure, and that the final scene of the predicted end—the great South African Desert—will not come in their time, nor even the first warnings of it. But a warning has already come. It is found in a study of the population census returns since 1856. Up to the year 1891, these returns showed a general increase of Europeans in the several States that to-day form the Union. Some districts have naturally shot ahead more rapidly than others, but generally there was progression. Since 1891, however, the returns show not only varying speeds of growth, but also actual retrogression or decrease of the European population in some districts. And the arresting feature is that it is the same districts which time after time in these later years show a constant decrease. This is undoubtedly a seriously unhealthy condition in a young country which instead of declining should be expanding in people and production throughout its territory. It is in the Midland districts of the Cape Province (where since early days the old methods of small stock farming have been practised) that the "writing is seen on the wall." The population decrease commenced in Richmond in 1891, spreading through the surrounding country, until in 1904 the Census revealed an affected area roughly outlined by straight lines joining up the districts of Hay, Willowmore, Albany, Albert, and thence back to Hay.

A DECLINING POPULATION.

Seven years later, in 1911, practically the whole area showed a further drop, while to the west and east new districts became affected, including the Orange Free State as far as Hoopstad. And the falling off has since continued, according to the 1921 Census, the decrease spreading moreover to additional districts, so that now the affected area is greatly enlarged.

There are, of course, legitimate reasons for a decrease in certain districts at certain times, such as the removal of a military garrison, the completion of some large engineering work, the closing down of mines, and so on. These happenings, however, will account for an

isolated decrease in population in a particular locality, but where the decrease is general and continuous over a large area, the trouble must be of a more serious and deeper nature. And such is actually happening within the area outlined above, but more significant still, the comparative decrease is growing in rapidity with the passing of time. A factor in the more recent decrease, for which allowance is made, is doubtless the influenza plague of 1918, which, however, affected the whole Union. Then also it may be argued that the northward trend of development has drained away an appreciable part of the population of this older Midland area of the Cape Province. Yet while other main areas of that Province also shared in the drain (as well as in other abnormal happenings that at the time were the means of decreasing the population), they have since recovered and are going ahead once more. But the Midland districts show no recovery; the decrease there has been unarrested. These districts in 1865 supported 30.5 per cent. of the whole European population of the Cape; but in 1921 supported only 17.3 per cent., the drop commencing in 1904, and the greater proportion of the decrease having occurred since 1911. Thus in 17 years the population in more than thirty Midland districts decreased by over 12 per cent.

Induced Emigration.

The loadstone that enticed away many of the inhabitants of the old settled parts of the country was great mineral and agricultural wealth, and it had apparently a stronger call in the Midlands than in other areas of the Cape. And because it is, generally speaking, the greater facilities for making a living in another district or country that induce a man to emigrate, so it seems that in the Midlands it has become relatively or actually more difficult to make a living than in the remainder of the Cape Province.

As is very well known, there has been marked progressive development in the greater proportion of the Cape Province due to many causes, and it may be, perhaps, that this forward advance has made life in those parts *relatively* more attractive than in the Midlands, although there may yet be no actual retrogression in that less favoured part. On the other hand, the trend may *actually* be backwards in the Midlands both in population and production. Even though the white population may decrease there is no reason, if the productivity of the land has not been impaired, why the number of small stock should also be reduced. Yet investigation shows that there has been a very considerable decrease in the number of small stock in the Midlands. Therefore, since this reduction cannot have been occasioned solely by decreased population, it must be due to conditions there having been disadvantageous to small stock. And that is actually the position. The reason for this decrease in the productivity of the Midlands was carefully sought by the Commission, and, on the evidence of many farmers, it unhesitatingly ascribes it to the deterioration of the vegetal cover and soil erosion. In other words, the declining European population of these parts is a first sign of that widespread deterioration of the country that is bound to result in a continuance of present methods of stock farming. It is an eloquent warning.

A SAVING INFLUENCE IN THE NORTH-WEST.

Now, the question will doubtless be asked: "Why should this position arise in the Midlands and not in the Cape North-West, where the rainfall is less, the variations as great, and the drought as severe?" The reason is this. Stock require water and food: drought losses are due directly to thirst and starvation and, indirectly, to disease which is more readily fatal when animals are impoverished. Where water is obtainable in reasonable quantity at reasonable distances during normal times, the number of small stock that may be grazed is limited, not by the watering capacity, but by the edible vegetation available. Under such conditions the veld (due to present wrong methods) is overgrazed, bringing ultimately ruination to the vegetation and soil erosion. And this actually is what has happened in the Midlands. On the other hand in the North-West, where drinking places are scarce, the number of small stock that may be grazed is limited by the water available. Therefore, although the veld in those parts may suffer even more from trampling, and the vegetation in the vicinity of the watering places be badly overgrazed as in the Midlands, yet because of the relatively smaller number of live stock that can be kept, the total damage done to the vegetation as a whole is less, the vegetal cover is not deteriorated to the same extent, and so the productivity of the district is not decreased in a like degree. It would seem, indeed, that by providing less water in the North-West, nature has prevented the farmers there from overstocking their farms, and so, perhaps, has saved them from themselves. She was more bountiful to the Midlands, but man there has abused the privilege, and she now begins to exact the penalty.

Nor are the first signs of the future disaster seen only in the Midlands. Overstocking in the Southern and Western Orange Free State is bringing about the same results—destruction of vegetation, spread of non-edible plants, soil erosion, and a dwindling population. Having been stocked for a longer period than the Orange Free State, the signs were first visible in the Midlands, but the ultimate end promises to be the same in the Orange Free State—diminished productivity and decreased population.

DROUGHT AND POOR WHITES.

The retrogression, then, of the Midlands is revealed by an analysis of the census figures for the past 56 years, and from the same source the Commission has endeavoured, by tracing the migrations of the population, to throw light on the share that losses from drought have had in reducing many Europeans to indigency. These migrations would indicate, it was considered, the number of persons who have succumbed financially in the economic struggle for existence, or who have felt that there was no satisfactory outlook for them in their district. It was found in respect of some districts that emigration had taken place directly as a result of well-known events, such as mining and military causes, collapse of the angora market, etc., while in many instances the failure of farmers to retain possession of their land was clearly traced to such causes as (*a*) droughts, hailstorms, and untimely frosts; (*b*) jackals; (*c*) stock and plant diseases, and insect pests working separately or in conjunction with droughts; (*d*) cataclysms, such as war, etc.; (*e*) too

minute sub-division of farms; (*f*) inflated prices paid for ground; (*g*) want of general agricultural education and training; (*h*) inability to dispose of farm produce at reasonable rates. Some are causes that could not have been circumvented, but their consequences would have been less disastrous were the elements of successful agriculture generally present in a sound system of farming. Thus no definite conclusion could be arrived at by the Commission in this instance, for the relationship between stock losses and emigration has not been very marked, although emigration and stock losses have both been largest in the semi-arid districts of the country.

The economic factors that have reduced the population of the Midlands are showing their ill results in other ways besides diminishing productivity and population. It is not every man who leaves his district after it has become financially impossible for him to live there. Indeed, there are many who, by clinging to their particular part of the country, sink in the increasingly hard fight to secure a living under those man-made conditions that reduce instead of promote the productivity of the land. Thus the cumulative evil that has driven away the population of the Midlands is also largely responsible for the alarming numbers of indigents that now confront the country as a "Poor White Problem." Thus it is that in this form also wrong farming methods are exacting a far-reaching retribution. The increasing number of indigents (many indeed are still clinging to the land while others are drifting to the cities) is the final picture of a sequence of misfortunes due to economic reasons combined with the induced disabilities of unfit parents, inbreeding, under-feeding, and disease.

THE WAY OUT.

In dealing with this problem in a land where normally prosperity should be the heritage of every intelligent farmer, the Commission offers suggestions as to the means whereby the trouble may be mitigated and in time removed.

Many of the misfortunes that lead to the failure of the farmer reach their climax through drought. Whatever may be done to mitigate the above-mentioned causes would result in a reduction of the failures at all times, and the Commission considers that increased facilities for marketing with better roads, and better railway and harbour facilities, would undoubtedly reduce poverty on farms by making increased production worth while, and that factories for utilizing perishable produce are desirable. But of fundamental importance is the need for better agricultural education and training. A closer relationship between the farmer and the Department of Agriculture, with the technical advice it can furnish, is necessary. And in the organization of the farmer is to be found the link that will keep the farmer and the Department in close touch.

Having arrived at these conclusions founded on the solid support of practical experience corroborated by scientific analysis, the Commission recommends the Government to do its utmost to abolish the kraaling system and make it as easy as possible for the farmer to put the paddock system into practice. To effect this the jackal must be exterminated, provision must be made for the supply of cheap fencing material, and for the development of water for stock purposes.

In dealing with these matters, organization of the farmer, it is repeated, is the first essential, while the State has to assume certain responsibilities in the control of soil erosion, and the Department of Agriculture has to investigate certain grazing and fodder problems.

In commenting upon some of the dangers to which the unwary farmer is exposed, a warning is sounded by the Commission against the folly of paying too big a price for land. Many a farmer is crippled at the very commencement of his activities through this indiscretion. All his available capital and perhaps all he could borrow, is locked up in the land, so that fencing, dam-making, boring for water, and improvement of stock become impossible. In his efforts to overcome his difficulty he allows his farm to be overstocked —and the end too often is bankruptcy.

Another matter is the practice of sending sheep away by rail in times of drought. Here organization would enable a system being introduced whereby farmers who want grazing for their stock and those who have veld to lease could be brought together. But this practice is in itself not the desirable solution. Instead of moving the animal to the fodder, it is possible, and may be better to bring the fodder to the animal. Usually a farmer does not decide to " trek " until the situation on his farm has become hopeless, by which time his animals have become very low in condition. In this state the fatigue of the journey alone may cause considerable mortality among the suffering animals. Then, also, this trekking of animals results in temporary overstocking of some portion of the country to its detriment. For many reasons the transport of the fodder instead of the animal is the better method, but better still is the provision of reserve fodder that every wise farmer should make to tide over the dry periods. It can be done at comparatively small expenditure of money and labour. For instance, the propagation of spineless cactus ensures a reserve of succulent fodder that is invaluable.

THE LIGHT OF EDUCATION.

Thus while, as in every country, there are victims to circumstances that are beyond control, it is clear that education, which must include a good knowledge of at least the main principles of farming in South Africa, is the bulwark that will keep our farmers safe from the fate that ignorance has brought to so many of our indigents. It is the light that will show the way to the reclamation of our overgrazed, denuded, and eroded areas, and show us how to dam the ebbing tide and turn it into a flood of returning prosperity.

But while the way of combating the danger is shown to the solvent farmer, there is still the problem of those who have failed. The Commission makes certain suggestions for their succour, such as afforestation work; establishment of labour colonies under certain given conditions, the encouragement of home industries, the provision of industrial education, development of the iron industry, or other new industries which from their nature are difficult for the individual to establish, such as a beet sugar industry, etc.

The picture of shrinking population, declining productivity, and indigency that this chapter conjures in the mind, portrays the fate that has overtaken those who through ignorance, and maybe slackness, have neglected their best interests, or who perchance have been

caught by circumstances that offered no means of escape. But it is not a picture of unrelieved gloom. It is one indeed glowing with hopefulness, for escape from the toils is certainly possible. Moreover, in these same declining districts there are to be found farmers who, by industry, courage, and foresight, have become prosperous, and have demonstrated that South Africa, even in her most forbidding aspect, is a land of great promise to him who treats her well and with understanding.

(NOTE.—For further details of the subjects dealt with in this Chapter, see Chapters XVIII and XXIX of the Drought Commission's Report).

(To be continued.)

A Trade Exhibition in New Orleans.

A Trade Exhibition, which will be of an international and permanent character, is to be opened on the 15th September, 1925, at New Orleans, United States of America. This centre, it is pointed out, is admirable for such an exhibition, particularly as it is the connecting link between North America and South America, and also the Orient by way of the Panama Canal.

Space of various dimensions for display purposes is available at a yearly rental. Full particulars of the purposes of the exhibition, hire of space, etc., may be had on application to the American Trade Commissioner (Mr. Perry J. Stevenson), P.O. Box 6989, Johannesburg.

Outbreaks of Animal Diseases: July, 1925.

Disease.	Transvaal.	Natal.	Cape.	Orange Free State.	Transkei.	Total for July, 1925.	Total for Calendar Year, 1924.
East Coast Fever	—	2	—	—	—	2	125
Mange	29	6	25	1	20	81	455
Anthrax	7	7	1	6	23	44	1,494
Dourine	2	—	—	—	—	2	14
Glanders	1	—	3	—	—	4	56
Tuberculosis	—	—	—	—	—	—	18
Epizootic Lymphangitis	—	—	—	—	—	—	2

HOP GROWING.

Report on Experiments, 1924-25.

By E. BAKER, B.Sc., Lecturer in Botany, Elsenburg School of Agriculture.

PROMISE OF A GOOD SEASON.

As indicated in last year's report,* the general scheme of manuring adopted at George closely approaches to that employed in Kent.

The season 1924-25 appeared to be particularly good for hops, as rain fell at regular intervals, and at no time in excessively large amounts. The growth of bine, in fact, was too luxuriant, but it was thought that through this some useful information might be obtained in respect to the schemes of manuring adopted.

To militate against south-east winds, which damage the crop every year, a screen of poles and gum thinnings was erected in November. This screen serves a useful purpose, and undoubtedly saved more loss even in its first year than the cost of its construction.

A DAMAGING WIND.

Picking commenced on the 16th February, 1925, or three weeks earlier than in the previous season, in an attempt to save the crop from damage by the "berg wind," which usually appears about the end of February. On the 22nd, however, from about 1 a.m. to 2 p.m., a heavy berg wind arose, and this did a great deal of damage to both gardens. The old garden suffered most, as here the growth of the older hills was most luxuriant. The accompanying photographs will serve to give some idea of the wreckage caused. Both poled hops and those under wire suffered, but the poled portion was worse. The damage was also accentuated through the use of gum poles instead of wattle. It has been stated before that the young gum saplings are useless, as they are too brittle. It is doubtful, however, whether wattle poles would have stood up against the gale experienced on the 22nd February.

RESULTS OF THE STORM.

On the 21st, the prospects for a good picking were excellent, and it was estimated that at least a ton of hop would be secured as against 500 lb. of the previous season. Also, the sample kilnings, K1 to K11,

* Published in the October, 1924, issue of the *Journal*. – EDITOR.

put through the small oast, were more even in colour and quality than anything we had previously obtained. One or two of the samples were equal to much of the hop that was seen in England in 1924.

It was quite the reverse from the 23rd onwards. Extra labour was employed to save as much hop as possible, but, although the kiln was kept going day and night, a great amount of bruised and discoloured hop resulted. A large amount of damaged hop was discarded, and it is estimated that from 500 to 700 lb. were lost. The small-sized oast house is, of course, a limiting factor in such circumstance,

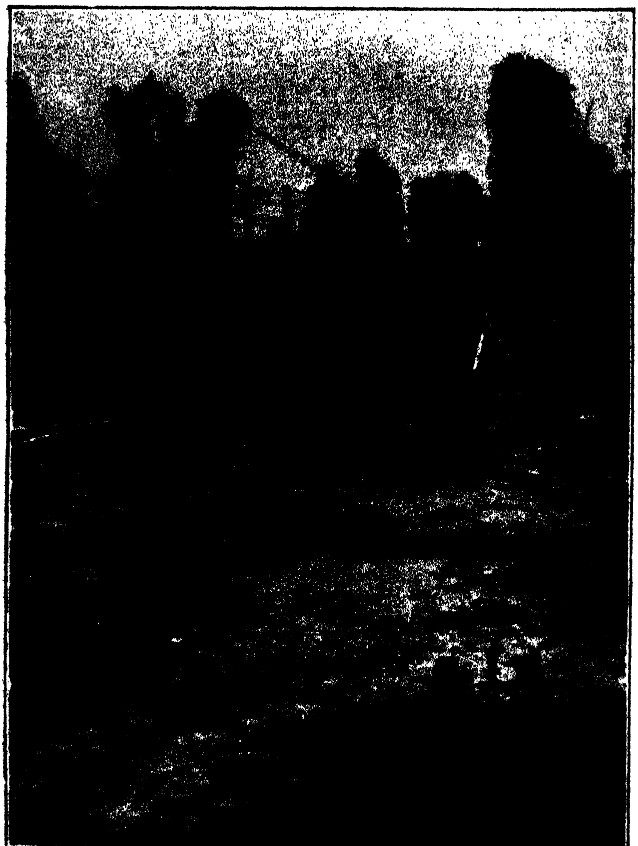


FIG. 1.—Damage by Wind.

for one can only pick as much as the oast can manage within the twenty-four hours each day.

CHANGE OF SITE.

The wired portion withstood the winds best, and it is evident from observations made in previous years that if the experiments are to continue at George the whole garden must go under wire. If it is suggested that the experiments might be continued elsewhere, then,

FIG. 2.—Damage due to Gale.

FIG. 3.—Hop Pickers. Luxuriant growth on poles.

unless suitable strong poles can be obtained cheaply, "wiring" would also have to be the method adopted. Mention is made here of a change of site for the experiment, because a Mr. Hamilton—a hop merchant from New Zealand, recently here—stated that in Tasmania a good deal of hop is grown under irrigation methods. If this is so, it may be possible to find a more suitable place than George for the continuance of the hop experiments.

For the next two years, however, it is suggested that the experiment at George be continued, using the wire system of cultivation. Except for the construction of an additional small oast or kiln, the cost of the experiment has now reached its maximum—approximately £450 per annum. With the extra acreage under hop, the yield, even at £10 per cwt., should make the experiment self supporting. This year, despite the fact that the berg wind caused a loss of some 7 cwt.,

FIG. 4.—Screen erected to shelter garden.

[*Photo taken December*, 1924.

1,500 lb. of dried hop were dispatched to the breweries, as against 500 lb. for the season 1923-24.

MANURIAL PLOTS.

For the most part it was impossible to make any accurate check on the manurial plots. An attempt was made with the wired portion of the old garden, but here, again, the results as shown by the figures are misleading. It was evident about the 15th February that plots 16-19, which have been receiving double dressings of artificials in addition to lime, were better than plots 2, 3, 4, 6, and 7. When picked, however, after the storm—these latter plots showed heavier returns, due to the fact that they had suffered less from the wind rather than to any manurial treatment. The results, however, of 1923-24 and 1924-25 in the wired portion are given, as they show at least that the yields are improving.

YIELD OF GREEN HOPS IN POUNDS PER ACRE.

Plot No.	1923-24.	1924-25.	*Plot No.*	1923-24.	1924-25.
*1	910	900	11	400	960
2	1,360	1,200	12	440	880
3	840	1,380	13	360	1,120
4	800	1,240	14	320	1,080
*5	1,120	1,000	*15	240	720
6	960	1,280	16	200	1,200
7	560	1,600	17	240	840
8	520	1,360	18	200	960
9	320	1,000	19	160	1,080
*10	400	880	*20	320	760

During the season 1923-24, plots 7 to 20 under wire made poor growth and also suffered a great amount of damage.

For the season 1924-25, it is estimated that about 50 per cent. loss resulted in plots 10 to 20 owing to the fact that these plots suffered from wind, and that by the time they could be picked they were overripe and withered.

* Check Plots.

Agricultural Legislation.

List of Acts having a direct interest to the farmer, passed during the 1925 Session:—

(1) Public Auctions and Transactions in Live Stock and Produce Act.

(2) Agricultural Industries Advancement Act.

(3) Orchard Cleansing Act.

(4) Stock Diseases Act Further Amendment Act.

(5) Co-operative Societies Act Amendment Act.

(6) Fruit Export Control Act.

(7) Wild Birds Export Prohibition Act.

PINUS INSIGNIS Doug. (*Pinus radiata* D. Don) IN SOUTH AFRICA.

With Special Reference to its Growth at Tokai Plantation, Cape Province.

By N. L. KING, District Forest Officer, Tokai, Cape Province.

Part II.

ESPACEMENT.

From time to time opinion as to the espacement at which *Pinus insignis* should be planted or sown has varied. In the early work at Tokai and elsewhere espacements of 10 feet by 10 feet, 12 feet by 12 feet, and even wider were used. As a result of this wide planting the trees became too branchy, and it was evident that either pruning or alternatively a closer espacement was necessary. The latter measure was adopted and there followed a period of dense planting—the trees being spaced as close as 3 feet by 3 feet. This, however, did not prove an unmixed blessing. It certainly kept down the side branches, but necessitated also very early thinnings. In many cases these were not carried out, with the result that the trees either toppled over or else lost their vitality.

At the present day an espacement of 6 feet by 6 feet is considered to be, generally speaking, the most suitable for *Pinus insignis* if timber of good quality and large dimensions is required. Local conditions must, at the same time, be taken into consideration. In remote localities where thinnings cannot be disposed of at remunerative rates, it would perhaps be preferable to adopt a wider espacement, such as 8 feet by 8 feet or 9 feet by 9 feet. This procedure not only reduces the initial cost, but also reduces the work in connexion with subsequent thinnings.

The wider espacements suggested would also appear to be desirable when trees are grown for boxwood or for matchwood. The larger growing space allotted to each tree encourages diameter growth and thus a merchantable crop of timber can be obtained in a shorter period. For neither of these purposes is it necessary to have a close-grained timber. The increased difficulty in regard to knots which will probably result from the wider espacement can be overcome by pruning.

FILLING OF BLANKS.

Blanks which may occur in planted or sown areas should be filled not later than the following season. Should this necessary operation be further delayed the original plants will probably suppress those introduced later.

In planting operations it is advisable to go over the ground about a month after the planting has been done. It is generally possible to tell by this time those plants which have not "taken," and they can be replaced without the loss of a season.

Blanks in *in situ* sown areas should not be resown, but rather filled with good strong plants.

CULTIVATION AND WEEDING.

At Tokai one hoeing and weeding is generally necessary before the plants are able to compete with the natural vegetation and weeds. This cultivation is generally carried out when the trees are from 18 months to 2 years old. In very weedy ground it may be necessary to cultivate sooner and then later on repeat the operation.

THINNING.

Pinus insignis must have ample growing space to keep it healthy and vigorous, for when once over-crowding is permitted the trees appear to lose their vitality and are unable to respond to thinning. Heavy and regular thinnings, commencing at an early age, are therefore imperative to the attainment of a good timber crop. In the absence of complete data, the optimum number of stems per acre at the different ages and under varying conditions of locality cannot be laid down definitely. From a study of various stands at Tokai Plantation, the following table indicates a suggested density of stocking during the history of the stand in localities similar to Tokai:—

TABLE 2.

Age : Years.	Number of Stems per Acre.	
	Original Espacement 6 ft. × 6 ft. (i.e 1,210 stems) per Acre.	Original Espacement 9 ft. × 9 ft. (i.e. 538 stems) per Acre.
10	550	275
15	320	200
20	200	150
25	130	130
30	130	—
35	130	—
40	130	—

The above figures are intended merely as a guide to show roughly the growing space which should be given to the trees at various ages. In actual practice, the vigour of the trees, spread of

crown, and nature of the undergrowth should be taken into consideration. Vigorous stands can be thinned more heavily than those that are unthrifty.

The first thinning in a stand should not, as a rule, be carried out until the weeds and undergrowth have been suppressed and the lower branches have begun to die.

PRUNING.

Pinus insignis does not readily shed its dead branches, even with a very close espacement, and in order to obtain clear timber there is practically no alternative but to prune.

The question of pruning is an important one, particularly when the tree is grown purely for boxwood or matchwood. For these purposes it is desirable to produce the lumber in as short a space of time as possible. Strength is not very necessary and the main requirement, apart from colour, toughness, etc., is that the wood should be free from knots. The elimination of knots can be accomplished only by pruning, and to be quite effective will involve not only the removal of the dead branches, but most probably some of the living branches as well. Because of the divided opinion which exists as to the advisability of pruning living branches, this latter aspect of the matter should be considered. Hartig* has dealt very fully with the subject and his conclusions are that in most cases the removal of green branches diminishes the amount of growth, and that very severe pruning weakens the tree and consequently retards the occlusion of wounds; on the other hand pruning improves the form of the stem and produces a clean bole. He considers that a limited amount of pruning is not injurious to the tree, provided that the work is done carefully. He recommends that the operation be carried out during autumn or winter when growth is at a standstill, and the cortex least liable to be detached from the wood. During the growing season when the cambium is active, it is quite impossible to avoid loosening the cortex.

Hartig also refers to the danger of leaving snags on the stem and emphasizes the necessity of cutting off the branches as closely as possible to the stem.

Schlich † agrees with Hartig that pruning improves the shape of trees and approves of the pruning of green branches up to 3 inches in diameter.

Hawley ‡ states that pruning of live branches to a limited extent (for not over 10 per cent. of the depth of the crowns) is not likely to have injurious effects if done in young stands when the branches are quite small. He suggests that pruning be carried out to a height of 16 to 25 feet, and that three or four prunings be made at intervals of several years. He is further of opinion that pruning will become a regular operation in intensive management, particularly in plantations.

* "The Diseases of Trees," R. Hartig.

† "Manual of Forestry," Vol II, Schlich.

‡ "The Practice of Sylviculture," Ralph C. Hawley.

There is much to recommend the practice of pruning. It permits the adoption of a wider planting espacement with consequent reduction in the cost of formation, shortens the period necessary to produce timber of the desired size, and at the same time results in the production of cleaner timber. It should always be carried out, however, when the trees are quite young; otherwise no good purpose will be served and the expense incurred will be money wasted.

The age at which pruning should commence and the height to which it should be carried will vary according to the locality. As a general rule, it may be stated that pruning should not be started until the lower branches begin to die. In the case of *Pinus insignis* this will be from 7 to 10 years after planting, depending upon the espacement. The first pruning should be carried to a height of about 10 to 15 feet, whilst the second pruning made 4 or 5 years later should be done to a height of 20 to 25 feet. The number of stems per acre to be pruned will be dependent upon the object for which the trees are being raised. Where the aim is to produce large timber on a rotation of about 35 years, then not more than 130 stems per acre should be pruned. These, which will form the final crop, should be the most robust and best shaped trees in the stand. In the case of trees grown for boxwood or matchwood, from 200 to 250 stems per acre should be pruned, as, after the second thinning, practically the whole of the remaining crop will be used for the purpose in view.

Pruning should be effected during the winter months when there is little movement of sap; the occlusion of the wounds commences with the vigorous spring growth immediately following.

It is of importance that the branches should be removed as close as possible to the stem. The instruments used are either a saw or a sharp matchet or axe. In using the matchet or axe the cut should be made from the side and not with a downward stroke.

The cost of pruning will amount roughly to 1d. to 1½d. per tree for each operation. The improved quality of timber obtained will more than compensate for this expense.

GROWTH AND YIELD.

Rate of Growth.—For the first two or three years after planting the rate of growth is not very great. After this the tree begins to grow with extraordinary rapidity. At about the 12th to 15th year the rate of height growth culminates, although it continues to be fairly rapid until the 24th or 25th year. No further great increase in height occurs after this age.

Unfortunately complete data of growth for all localities are not available.

The following height and diameter table indicates the rate of growth in different types of locality. For comparison figures from Monterey are also given:—

TABLE 3.

Station.	Age of Trees.	Mean Diameter at 4 ft. 6 in.	Mean Height.	Original Espacement.
	Years.	Inches.	Feet.	
Tokai	4	2·8	20	6 ft. × 6 ft.
	8	3·9	42	4 ft. × 4 ft.
	12	4·9	60	4 ft. × 4 ft.
	27	11·9	95	3 ft. × 3 ft.
	33	18·4	100	Not known.
George...	18	10·2	90	" "
	24	13·8	95	" "
Knysna	11	5·2	69	5 ft. × 5 ft.
Kentani	23	8·3	66	Not known.
Fort Donald	19	12·0	85	" "
	25	16·0	85	" "
Harrismith	9	4·7	28	" "
Monterey	5	2·6	20	Natural forest.
	10	6·2	39	" "
	15	9·4	53	" "
	20	12·0	64	" "
	25	14·2	72	" "
	30	15·7	76	" "
	35	17·0	80	" "
	40	18·1	82	" "

Yield.—Reliable data in regard to yield are very scanty. The following figures are on record and represent the yield per acre, inclusive of bark, in different localities in South Africa:—

TABLE 4.

Station.	Age of Trees.	Main Crop.	Thinnings.
	Years.	Cubic Feet.	Cubic Feet.
Tokai	4	550	—
	12	3,684	2,560
	27	9,766	Not known.
	32	11,355	" "
	33	10,048	" "
Knysna	11	4,989	583
Hogsback	32	*7,311	Not known.
Kentani	23	5,315	" "
Fort Donald...	25	10,400	" "
Harrismith	9	2,260	" "

From measurements made in young stands at Tokai and from stem analyses made of older trees, the following table indicating the average yield per acre has been compiled. It gives the average yield which may be expected from *Pinus insignis* grown on suitable

*Represents an under-bark measurement. The over-bark measurement is approximately 8,530 cubic feet.

sites in that locality. The figures represent under-bark measurements:—

TABLE 5.

Age.	Espacement 6 ft. × 6 ft.		Espacement 9 ft. × 9 ft.	
	Main Crop.	Thinnings.	Main Crop.	Thinnings.
Years.	Cubic Feet.	Cubic Feet.	Cubic Feet.	Cubic Feet.
10	2,000	1,200	1,250	625
15	4,500	1,250	2,850	750
20	5,400	1,400	5,260	—
25	5,800	1,575	—	—
30	7,600	—	—	—
35	8,900	—	—	—
40	10,100	—	—	—

Taper.—The available records indicate that the taper of the stem is very constant. From a series of measurements of trees at Tokai, 30 to 35 years of age, it was found that the form factor averaged .45.

Bark.—In young and healthy trees the bark is reddish. This becomes dark and deeply fissured as the tree grows older. The thickness of the bark is a factor which is not subject to great variation. Determinations made at Tokai on trees 28 to 33 years old show that it averages 16 per cent. of the total volume of the boles.

Rotation.—The rotation of a timber crop is that period which elapses between the time of formation and the cutting of the final crop. The greatset factor governing the rotation is the object for which the trees are grown, e.g. if boxwood is required then a shorter rotation can be adopted than is necessary for the production of large timber for structural purposes.

It is inadvisable to lay down any definite rotation for *Pinus insignis* in South Africa owing to the differences of locality which are encountered. Generally speaking, however, it may be said that in suitable localities a rotation of about 20 years will be sufficient for the production of boxwood, provided always that due attention is paid to the question of thinning. If structural timber is required it appears that a rotation of from 35 to 40 years is necessary.

DANGERS TO WHICH *Pinus Insignis* IS EXPOSED.

Diseases.—When planted in suitable localities *Pinus insignis* is not very susceptible to disease. Apart from *Diplodea pinea,* most of the disease-causing fungi with which the tree has to contend are those which appear in the very early stages of the life-history. Except for a little nursery trouble, *Pinus insignis* in the Cape Peninsula has been quite free from disease for 20 years or more.

Damping Off.—In common with the seedlings of many other species those of *Pinus insignis* are susceptible to "damping off" in the nursery. To a very large extent the disease may be prevented by the adoption of autumn nursery sowings. By the time that

germination takes place the weather is too cold for the disease, even if it does appear, to make much headway.

Pestalozzia and Fusarium spp.—Transplants from Lebanon, Caledon Division, have been found to be infected with *Pestalozzia hartigii*, which destroys the cortical tissue just above the ground level and causes the death of the plants. Another species of *Pestalozzia* has been found at Hankey, Eastern Cape Province, attacking the stems of young nursery plants. Both at Hankey and at Knysna there has from time to time appeared a wilting disease of transplants. The responsible organism is a species of *Fusarium*. In these diseases infection spreads through the soil and the diseases are in consequence difficult to control.

Phoma.—A seedling disease caused by a species of *Phoma* has been recorded from Belfast, Transvaal.

Hysterium pinastri.—In 1899 the fungus *Hysterium pinastri* made its appearance at Tokai. It attacked the leading shoots of the trees and caused them to die back from the top. The disease, however, soon died out, and no further trouble has since been experienced.

Diplodea pinea and Pestalozzia funerea.—Within the summer-rainfall area, however, the danger of disease is much greater. The tree here is susceptible to infection by two fungi, *Diplodea pinea* and *Pestalozzia funerea*, which attack both the leading shoots and terminal shoots of side branches. The spread of both these diseases is greatly favoured by wounds caused, for example, by severe hailstorms. The fact that *P. insignis* is easily damaged by hail and consequently rendered very liable to infection by these wound parasites tends to make the species unreliable in areas where severe hailstorms are of frequent occurrence. Both these diseases are described by Fisher in the *Agricultural Journal for the Union of South Africa*, March, 1912.

Insects.—Although various insects have been recorded on *Pinus insignis* in different localities, in no case as yet has the damage done been of a serious nature. Records of the following insects on *Pinus insignis* are available:—

Odontionopa sericea.—In the neighbourhood of Tokai, *Pinus insignis* is attacked by a small, bright metallic green beetle, *Odontionopa sericea*. This beetle gnaws the needles partly through about the middle and causes the upper portion to die. The damage done is very slight.

Nudaurelia cytherea.—In the eastern districts a certain amount of defoliation is at times caused by the caterpillar of the moth *Nudaurelia cytherea*. This insect, under the name of *Antherea cytherea*, has been fully described by James Sim in the *Cape Agricultural Journal*, Vol. XXII.

A closely related species, *Nudaurelia belina*, caused damage in a plantation in the Orange Free State. Advantage was taken of the fact that the larvae pupate was in the soil and some pigs were turned into the plantation. This measure eradicated the pest.

Gonimbrasia tyrrhea.—The larva of another Saturnid moth, *Gonimbrasia* (*Angelica*) *tyrrhea*, causes a certain amount of damage in *Pinus insignis* stands by defoliating the trees. This pest is

described by Hardenburg, in Bulletin No. 55, of 1912* of the Department of Agriculture.

Pachypasa spp.—The hairy larvae of *Pachypasa capensis* have been recorded at Pan Plantation, Transvaal, where they were defoliating *Pinus insignis*. The larvae descend and congregate down on the trunk of the tree prior to pupating, and advantage is taken of this habit to destroy them when they are grouped together, either by crushing or by shrivelling them with a small blast lamp.

In 1921 a species of *Pachypasa* appeared at Elgin, Cape Province, and defoliated a number of trees. The larvae behaved in much the same way as those of the *Pachypasa capensis* at Pan and were destroyed. Some material was submitted to the Senior Entomologist, Capetown, for examination, but all the larvae died from some disease before it was possible to ascertain the specific identity of the pest.

Colasposoma pusillum.—At Graskop, Transvaal, a Chrysomelid beetle, *Colasposoma pusillum*, was found to be damaging to a slight degree the needles of *Pinus insignis*.

Cockchafers and crickets sometimes cause a small amount of damage to young plants by biting through the stems.

Soft Scales: *Lecanium hesperidum, var. Pinicola.*—The presence of soft scale on *Pinus insignis* in the Western Cape Province has been reported. While little can be done in the way of practical control, the pest is not likely to prove serious, and natural enemies and other factors will probably keep it in check.

CLIMATIC DANGERS.

Hail.—Within the summer rainfall area there is always a danger of hail damage to *Pinus insignis*. It is through the wounds caused by the hail that infection by *Diplodea pinea* frequently occurs.

Snow.—At high altitudes a certain amount of damage is caused by heavy snowfalls. In this respect, however, the danger is probably not greater than in the case of other pines.

FIRE.

Pinus insignis is very sensitive to injury from fire, and particularly so during the first ten or fifteen years. After this the danger is not so great, but at all times protective measures must be taken. The usual method is to maintain fire-lines around the plantation and to divide the plantation itself into compartments of suitable size, these in their turn being protected by means of fire-belts. The belts need not be open ones. Strips about 30 feet wide, on either side of roads or paths kept clean of needles, serve the purpose.

TIMBER.

The wood of locally grown *Pinus insignis* is white when freshly cut, but may change on exposure to a light yellowish colour, and there is no very apparent difference in appearance between heart and sapwood, as there is in *Pinus pinaster* and some other pines. There is a pronounced figure on flat sawn surfaces which is emphasized in the more resinous boards. It is not, however, a resinous wood compared with pitch pine and has no scent. Although grown in this

* Reprint from *Agricultural Journal of the Union of South Africa*, September, 1912.

country at a much faster rate than the Baltic deal (*Pinus sylvestris*) in its habitat, it is very similar in appearance to the sapwood of this timber. It is, however, rather tougher, and this toughness seems to increase on exposure and is felt when hand-planing or sawing. On account of frequent knots in the timber, the wood is inclined to rough up when machine planed, but a very good surface can be obtained by hand-planing and in addition the wood sandpapers very well.

As regards turning it is suitable for rough work only on account of its tendency to rough up. Although it is well fitted for varnishing or paint work, it does not stain well, becoming patchy and unsuitable for polishing. It is admirably suited for all sorts of splitting and a good joint can be obtained by gluing. As regards strength, preliminary tests carried out by the Department on loaded beams indicated that *Pinus insignis* is as strong as imported deal.

The weight of *Pinus insignis* taken from the average of some twenty tests made on timber thirty-seven years old from Tokai, Cape Province, is 30.6 lb. per cubic foot oven-dry, which means that air-dry it would weigh between 33 and 34 lb. per cubic foot. There are, however, considerable differences in the weight, which varies according to the rate of growth and the amount of resin in the wood. Of a shipment of 900 cubic feet received from Tokai, about 20 per cent. was of a resinous nature, resembling *Pinus pinaster* rather than *Pinus insignis* and weighing approximately 35 lb. per cubic foot. The oven-dry weight of the clear *Pinus insignis* was 28.7 lb. per cubic foot. In some cases the more resinous wood was in the centre of the log, and in others it was nearer the outside. The average number of growth rings per inch in the samples examined was 4.5. One sample with only two rings to the inch weighed 24.3 lb. per cubic foot oven-dry. The green weight of *Pinus insignis* naturally varies with the amount of moisture in the timber, but may be taken as approximately 50 lb. per cubic foot.

One drawback to this timber is its tendency to decay or to develop "blueing" if not properly handled or left lying in the log for any considerable length of time. This tendency is more marked in *Pinus insignis* than in most other pines, and it is important to saw the logs into the required sizes as soon as possible after felling. If the boards are then properly stacked under cover or in well-ventilated sheds so that the air can circulate freely between the layers, which should be separated from each other by cross pieces or stickers about 2 feet apart, they may be seasoned free from blemishes of any kind. The pile should be weighted on top to prevent warping in the upper layers.

If, on the other hand, freshly sawn boards are close piled, a thick blue mould is almost sure to develop in a very short time. Although the strength of the timber may not necessarily be greatly affected by blueing, the discoloration detracts very much from the appearance and value of the wood.

The best time for felling is in autumn or early winter. Insect pests are not so active during these seasons. If the boards are stacked to season in the way described, they should be ready for use in the times shown below:—

½-in. boards	3 months.
1-in. boards	7 months.
2-in. boards	15 months.

Artificial seasoning of *Pinus insignis* has been tried with very successful results at the Pretoria seasoning kilns. A load of 150

cubic feet of ¾-in. boards was dried from the green state to an air-dry condition in thirteen days. There was no splitting, warping, or other defect due to the process, and the wood came out in excellent condition.

The thicker dimensions, i.e. over 2 in., are not so easily seasoned and need to be heavily weighted on top of the pile to keep them from warping. A load of 260 cubic feet of 3¼-in. deals was dealt with in the kilns. The time necessary to dry these deals from a moisture content of 41 per cent. (based on the dry weight) to an air-dry condition was 39 days. No doubt with further trials both these times could be materially shortened. It is interesting to note that any blueing which has commenced in the timber is prevented from spreading by kiln seasoning, and the fungus is destroyed.

Most of the seasoned wood mentioned above was used by the South African Railways for general work in the construction of trucks. A drawback with this timber was the number of knots which it contained, but this defect may be, to a great extent, eliminated by improved sylvicultural treatment.

Some of the kiln-seasoned material has been used by the Forest Department for packing cases and herbarium specimen frames. In the latter case the wood was planed up and varnished, and only material quite free of knots was used. In completely cutting out the knots in this way, it was estimated that about 30 per cent. waste occurred. The frames when finished presented a very pleasing appearance very similar to clear pine, for which *Pinus insignis* timber could be substituted in some cases.

It is also an excellent wood for shelving, ceiling, flooring, and joinery as well as for many other general purposes, such as cheap furniture.

A test made on *Pinus insignis* wood with regard to its use for match-sticks and boxes gave good results, and it was pronounced quite suitable both for the splints and boxes. The estimated loss from knotty material was 15 to 20 per cent., which is about the same as for poplar.

The framework of a wood and iron stable 48 feet by 14 feet was built of *Pinus insignis* timber in 1918, and also the window sashes, doors, louvres, mangers, 10 feet floor, etc. So far the timber has given entire satisfaction. It may be concluded from the foregoing that *Insignis* pine is a very promising timber as a substitute for imported deal.

FINANCIAL CONSIDERATIONS.

In any tree-planting scheme the question of the financial profitableness or otherwise of the undertaking naturally arises, and in this connexion it is advisable that some indication should be given of the expenses which are likely to be incurred and also of the returns which may reasonably be expected.

Expenses.—These will vary both in accordance with local conditions and with the method employed in establishing the plantation. Assuming that the soil is hand-picked with labour valued at 3s. 6d. per diem and that the plants are spaced 6 feet by 6 feet, then the cost per acre in the case of *Pinus insignis* grown on a 35 to 40 year rotation would be approximately as follows:—

TABLE 6.

Age. Years.	Service.		Expenses in Shillings per Acre.
Initial costs	Preparation of soil	£5 0 0	200
	Plants @ 6s. per 100	3 12 6	
	Transport and planting	1 7 6	
1	Filling of blanks		20
2	Cultivating		40
10	Thinning and pruning		60
15	" "		70
20	Thinning...		40
25	"		30

Administration and protection charges per acre per annum, 7s. 6d.

With a 9 feet by 9 feet espacement and a shorter rotation of 20 years, the costs would be roughly as follows:—

TABLE 7.

Age. Years.	Service.		Expenses in Shillings per Acre.
Initial costs	Preparation of soil	£5 0 0	150
	Cost of plants	1 12 0	
	Transport and planting	0 18 0	
1	Filling of blanks		10
2	Cultivation		40
10	Thinning and pruning		60
15	" "		50

Administration and protection charges per acre per annum, 7s. 6d.

A liberal allowance for costs has been made in the above tables. A considerable reduction in the cost of formation may be brought about by:—(1) Using ground which can be prepared by ploughing. (2) Raising the plants from seed purchased at 12s. per lb. instead of buying the transplants at 6s. per 100. (3) Sowing the seed *in situ*.

Returns.—In calculating the value of the returns which may reasonably be expected, a conservative value has been placed on the volume yields which have already been referred to in Table 5.

TABLE 8.

Age. Years.	6 ft. × 6 ft. Planting.			9 ft. × 9 ft. Planting.		
	Value per Cubic Foot.		Value in Shillings.	Value per Cubic Foot.		Value in Shillings.
	Main Crop.	Thinnings.		Main Crop.	Thinnings.	
10	—	1d.	100	—	2d.	100
15	—	2d.	200	—	2½d.	150
20	—	3d.	340	5d. net	—	2,120
25	—	4d.	510	—	—	—
40	9d. net	—	7,300	—	—	—

The value used above is not excessive; in fact, it is likely that better prices will be realized.

In calculating the values, firewood is estimated at 4 per cent. of the total volume and valued at 1d. per cubic foot.

The following table indicates the expenses and receipts per acre at the different ages:—

TABLE 9.

Age: Years.	6 ft. × 6 ft. Planting. Rotation of 40 Years.		9 ft. × 9 ft. Planting. Rotation of 20 Years.	
	Expenses in Shillings.	Revenue in Shillings.	Expenses in Shillings.	Revenue in Shillings.
..	200	—	150	—
1	20	—	10	—
2	40	—	40	—
10	60	100	60	100
15	70	200	50	150
20	40	340	—	2,120
25	30	510	—	
40	—	7,300	—	—

In addition to the figures given in Table 9 above, there is to be taken into account the annual administration and protection charge, which has been placed at 7s. 6d. per acre. Furthermore, it must be remembered that in making any calculation of the possible profitableness of the undertaking, compound interest at the desired rate must be calculated on all expenses and receipts, but generally speaking it will be found that such expenses are covered by the corresponding receipts.

Variations in local conditions will involve corresponding variations in the expenses and returns. It should be stated, however, that in the values adopted above the expenditure has been placed on the higher side and a conservative view taken of the receipts. In actual practice it is possible that even more favourable results than those indicated above will be obtained.

It is clear that for those who can afford to wait for a return on money invested in tree planting, and who are prepared to take the risk of fire, disease, etc., the planting of *Pinus insignis* in a good locality offers excellent prospects. Private owners by turning over ground which is not used for agricultural purposes to tree planting create a valuable asset, which not only has a practical value for farm purposes, but enhances the sale value of the farm.

A note as to the financial aspect of the sale of the large quantity of *Pinus insignis* timber from Tokai Plantation in 1918 will be of interest. In all, the trees, 32 to 35 years old, standing on an area of 163.4 acres were sold. The timber was put up to tender and disposed of to three parties at prices ranging from 1s. 6d. to 2s. 3d. per cubic foot. In terms of the conditions of sale the purchasers had to fell the trees and pay for all wood over 4 inches in diameter, exclusive of bark.

The total yield of *Pinus insignis* timber was 734,450 cubic feet, which realized £64,905. 1s. 5d. or £397. 4s. 4d. per acre. It may be mentioned that in addition to the *Pinus insignis* timber, the area also contained an estimated volume of 207,750 cubic feet of Eucalypt and other timbers. The area yielding the highest return both in volume and money was .7 acre in extent and yielded 6,813 cubic feet of timber, exclusive of bark, and a revenue of £766. 9s. 3d. Raised to an acreage basis, the volume is 9,733 cubic feet, yielding a gross revenue of £1,094. 19s.

It must of course be remembered that the above sale was put through at a most favourable time when prices ruled very high, but nevertheless the figures give a good indication of the possibilities of raising *Pinus insignis* in favourable localities.

The largest tree measured was 35 years old, 136 feet in height, with a diameter at 4 feet 6 inches from the ground of 38.2 inches and a volume, inclusive of bark, of 315-6 cubic feet.

In conclusion, the writer wishes to express his thanks to Mr. Woodbridge Metcalf of the Forestry Division, University of California, Berkeley, for valuable information in respect of the distribution, description, and measurements of *Pinus insignis* in California and the climate and soil conditions in Monterey; to Mr. Gill, formerly Conservator of Forests, South Australia; and to the Research Officers of the Union Forest Department.

Literature consulted has been acknowledged in the body of the article.

CITRUS CANKER ERADICATION.

INSPECTION WORK, JULY, 1925.

Farms Inspected—

Rustenburg District (*Hex River Ward*).—Buffelskloof No. 668, Bokfontein No. 647, Buffelshoek No. 900, Elands Drift No. 284, Roode Kopjes No. 171. Rietfontein No. 431, Rhenosterfontein No. 546, Modderfontein No. 247, Buffelsfontein No. 558, Grootfontein No. 606, Kromrivier No. 590, Waagfontein No. 557, Zuurplaat No. 822, Oorzack No. 568, Boschfontein No. 193, Waterkloof No. 4, Waterval No. 544, Kroondal No. 177, Arnoliestad No. 4, Baviaanskrantz No. 288, Beaufort West, Rustenburg Town Lands.

Pretoria District (*Crocodile River Ward*)—De Kroon No. 420, Hartebeesthoek No. 524, Greylings Post No. 111, Pretoria North.

Waterberg District (*Nylstroom Ward*).—Nylstroom Town Lands, Vischgat No. 1091.

Fresh Outbreaks.—Nil.

Total Number of Nursery Trees Inspected.—84,316.

Total Number of Trees Inspected.—128,474.

Total Number of Trees found Infected.—Nil.

Number of Inspectors engaged.—13.

THE LARGER CABBAGE MOTH.

(*Crocidolomia binotalis* Zell.)

By D. GUNN, Entomologist, Division of Entomology, Port Elizabeth.

THIS insect was first observed in the south-eastern area of the Cape Province three years ago at Selborne, Sundays River Valley, where it had injured a large number of cabbage and cauliflower plants. It was also found in gardens at Walmer and Port Elizabeth. As it might become an insect pest of economic importance in the future, the advisability of working out its life-history and designing measures for its control appeared desirable.

The larger cabbage moth is often mistaken for the small cabbage moth (*Plutella maculipennis*) by farmers in Sundays River Valley, the injury accomplished being of a similar nature.

FOOD PLANTS.

The larva of this insect is essentially a pest of cruciferous plants, more particularly of cabbage, cauliflower, turnip, and radish. It may also do considerable damage to such flowering plants as alyssum, nasturtium, and stocks.

NATURE OF INJURY AND DISTRIBUTION.

When the larvae emerge from the eggs, they first attack the lower surfaces of the leaves and remain feeding there until the leaves are almost skeletonized; subsequently, large holes are eaten, and they burrow into the heart or crown of cabbage plants. If the infestation is severe, plants may be ruined within a week. This pest is very partial to young plants grown in beds before transplanting to gardens and fields; in such cases of attack the plants die after the leaves and buds have been destroyed.

The larger cabbage moth is prevalent in all four Provinces of the Union and has also been observed in India, Ceylon, and Mauritius.

INFLUENCE OF MOISTURE.

During the past three years it has often been found that an important factor in determining the abundance of the moths lies in the prevailing meteorological conditions. Many observations made in gardens and fields in the neighbourhood of Port Elizabeth, and also at Walmer and Sundays River Valley, showed the larvae to be very sensitive to the effects of moisture, large numbers being destroyed during inclement periods. The spring and early part of the summer of 1921 represented a dry period, and, in consequence, considerable damage was caused to cruciferous plants, whereas when heavy rain fell in December, 1921, and January, 1922, the larvae were so reduced in numbers that the damage done during the following three months was quite negligible.

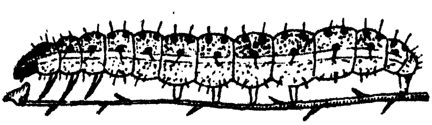
LIFE-HISTORY AND HABITS.

The Egg.—The egg is yellowish-green in colour and one millimetre or a twenty-fifth of an inch in length; it is flat and

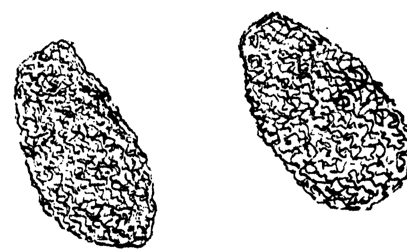
rounded-oval in outline. Eggs are deposited in masses on the undersides of leaves and also on the stems. A cluster may consist of from forty-three to over one hundred eggs, arranged so that they overlap like the scales of a fish. A day or two previous to hatching, the black head of the larva can be seen through the semi-transparent chorion or outer covering; otherwise, on account of the colour, it is difficult to detect the eggs on a plant with the naked eye.

The period of incubation depends upon the prevailing temperature. In warm weather the average time is eight days, whereas in cold weather this period may be prolonged to fifteen days.

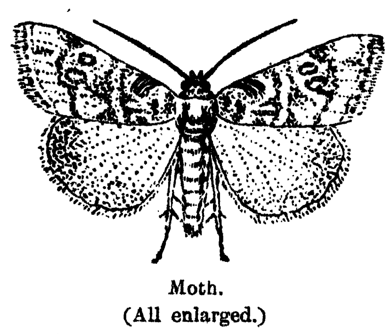
To ascertain the number of eggs deposited by a single individual, a number of gravid females were placed in separate cages in the insectary, and it was found that several deposited two and others three clusters of eggs, the average number of eggs in a cluster being ninety-five.



Larva.



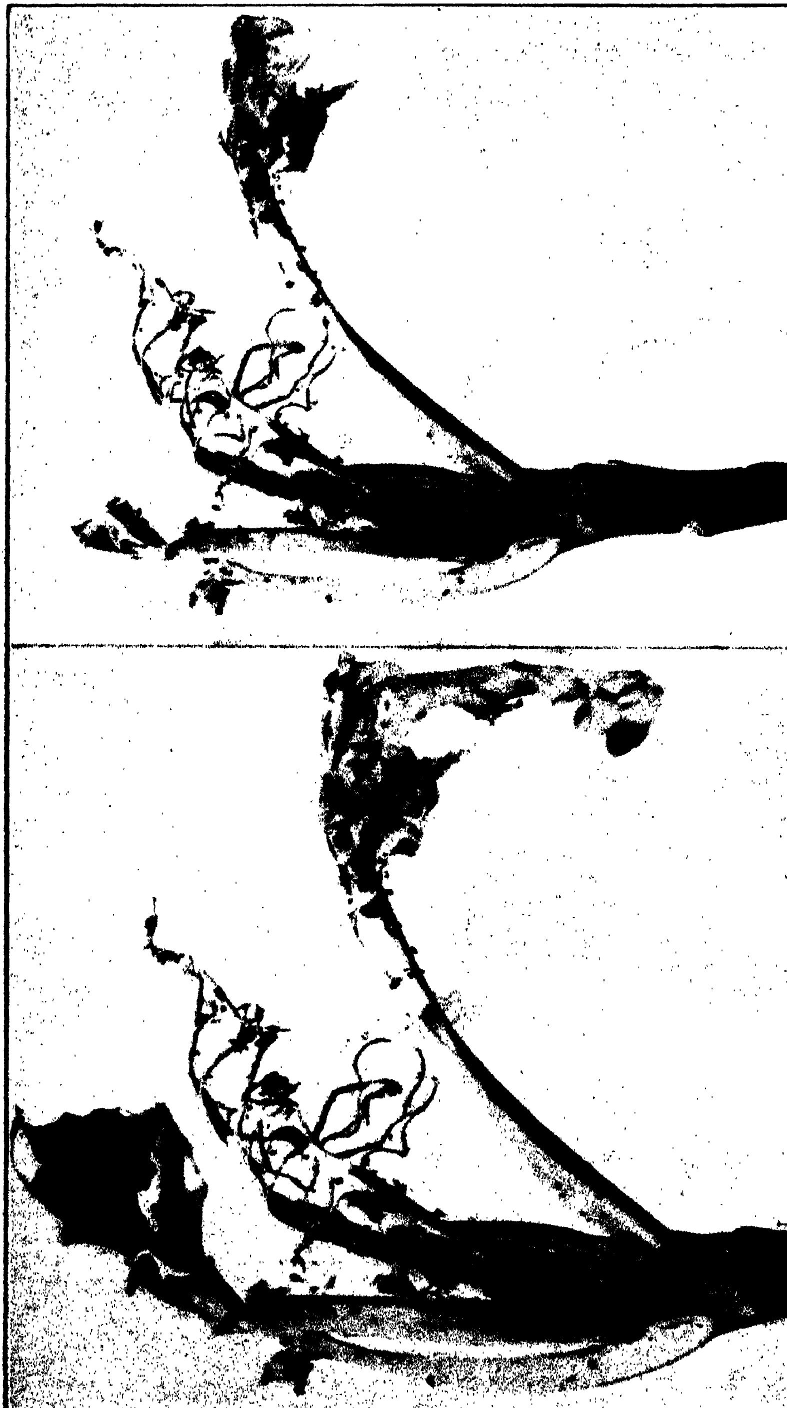
Cocoon covered with Particles of Soil.



Moth.
(All enlarged.)

The Larva.—When the larva emerges it is about 2 mm. or one-twelfth of an inch long. It is cylindrical in form and of a light green colour, except for the head, which is black, with a number of long white hairs scattered over the body. When mature, there are three longitudinal white lines on the dorsum or back and one along each side. The thoracic shield is black, and on the side of each segment there are three black dots arranged as the points of a triangle. The length varies from three-quarters to one inch.

At first the young larvae feed gregariously upon the lower surfaces of leaves, and as many as a hundred have often been found associated together. When, however, they are about two weeks old they scatter over plants until no more than about six are found feeding in one place. They have the peculiar habit of spinning a thick silk web over the part on which they are feeding, which appears to serve as a protective covering, and this habit is retained until they



Cabbage Plants Destroyed by Larvae of Larger Cabbage Moth.

are more than half-grown. Each larva also spins a silk thread, which is used as a means of progression when descending a plant.

In the summer months this stage occupies from twenty-four to twenty-seven days, whereas in winter it may be prolonged to fifty-one days.

The larva moults five times, the last moult taking place shortly before pupation.

The Pupa.—When the larva is mature it leaves the plant and burrows a little way below the surface of the soil. Here it spins a firm oblong cocoon, which is covered with small particles of soil, and after an interval of from four to seven days, pupates. The pupa or chrysalis is at first yellow, afterwards becoming dark brown. This stage may last from fourteen to forty days.

Adult.—In colour the fore-wings are pale ochre suffused with ferruginous markings. The hind-wings are grey, nearly transparent,

Larvae Feeding on Cabbage Leaf.

and slightly fuscous along the outer margin. The abdominal segments are silver-grey. The male may be easily distinguished from the female by the presence of a thick tuft of long hairs on the frontal margin near the base of the fore-wings. The fore-wings of the male, when fully expanded, measure from one to one-and-a-sixteenth of an inch across; the female about the same size.

The moths are nocturnal and are attracted to bright lights, especially during the summer months. During the daytime they hide under the leaves of cabbage and other cruciferous plants in gardens and fields and are readily observed when disturbed. They are strong fliers and can travel for some distance.

When a number of moths of both sexes were placed in the insectary and fed on honey and water, some lived for twenty days, but the majority died on the fifteenth day.

Number of Generations.—Life-history work was begun in May, 1921, when many mature larvae were collected and placed in cages in

the insectary. Moths emerged on 1st June, and eggs were deposited on cabbage plants on 5th June. With these eggs to start from, six generations were reared between 5th June, 1921, and 31st July, 1922.

Generations of Crocidolomia binotalis *Zell., Port Elizabeth,* 1921-1922.

Generation.	Date when Eggs were Deposited.	Date when Eggs Hatched.	Length of Egg Stage.	Larvae Pupated.	Length of Larval Stage.	Length of Chrysalid Stage.	Adults Emerged.	Total Developmental Period.
	1921.							
'irst	June 5	June 20	15 days	Aug. 10	51 days	40 days	Sept. 19	106 days
econd ...	Sept. 26	Oct. 1	5 „	Nov. 4	34 „	15 „	Nov. 19	54 „
							1922.	
'hird	Nov. 26	Nov. 30	4 „	Dec. 27	27 „	14 „	Jan. 7	45 „
	1922.							
'ourth ...	Jan. 12	Jan. 20	8 „	Feb. 13	24 „	10 „	Feb. 23	42 „
'ifth	Mar. 3	Mar. 12	9 „	Apl. 10	29 „	14 „	Apl. 24	52 „
ixth	May 5	May 20	15 „	June 30	41 „	31 „	July 31	87 „

HOW THE INSECT IS DISSEMINATED.

The principal means of dissemination of this insect is undoubtedly by the transport of cabbage and cauliflower plants from infested districts. Cabbage plants sent to Uitenhage and Port Elizabeth municipal markets for public sale were examined on several occasions during the past three years, and many were found to be infested.

ENEMIES AND PARASITES.

The Cape Wagtail (*Motacilla capensis*) was the only bird which was observed feeding upon the caterpillars in Port Elizabeth and at Sundays River Valley.

During the spring of 1921 a dipterous parasite (*Ctenophoraria blepharipus* B.B.) belonging to the family Tachinidae emerged from cocoons, but this parasite does not appear to be sufficiently abundant to control the pest. It was determined by the late Dr. Peringuey.

CONTROL MEASURES.

In our experimental work no difficulty was experienced in controlling the caterpillars by spraying and dusting with arsenicals. To prevent any great injury the work should be conducted with promptitude whenever plants are found infested.

Spraying and Dusting.—The most effective remedies to adopt are undoubtedly arsenical insecticides, and preference has been given to paris green and arsenate of lead powder, as these are more readily obtained than others. The following are the formulae recommended: (1) Paris green, 1 lb.; lime, 2 lb.; water, 100 gallons. (2) Arsenate of lead powder, 1¼ lb.; water, 40 gallons. (3) Arsenate of lead paste, 2½ lb.; water, 40 gallons. (4) Paris green, 1 lb.; lime, 30 lb. (for dusting). When paris green is used, lime is added to neutralize the free arsenic in the spray solution; to prevent clogging of the nozzle, the lime should first be passed through a fine sieve so that all lumps

are removed. When dusting with paris green and lime it is essential that the two ingredients should be thoroughly mixed before being dusted on plants. In the experimental work, small bellows, such as are used for dusting sulphur on grape vines, were employed, and these can be purchased at a hardware store where spray-pumps are stocked.

Cabbage Plants.—As young cabbage plants in a seed-bed are liable to become heavily infested before they are ready for transplanting, they should be examined at regular intervals to see if any caterpillars are present; otherwise they may be so severely injured

Cabbage Leaf Damaged by Larvae.

within a few days that they have to be discarded. As the caterpillars of this moth are much larger than the small cabbage moth (*Plutella maculipennis*) and destroy plants more quickly, spraying or dusting as a preventive measure is often advisable whether infestation has been observed or not.

As the outer leaves of cabbage plants are covered with a bloom that prevents arsenical solutions from adhering firmly to them, an adhesive substance should be mixed with the spray. The materials which were used with great success in our experimental work were resin and washing soda. The formula is as follows: Resin, 2 lb.; sal-soda or washing soda, 1 lb.; water, 1 gallon. Boil for slightly over an hour until the fluid is clear brown; afterwards add to fifty

gallons of spray solution. When propertly prepared, this adhesive mixture will keep for some time if retained in a tightly closed vessel.

After plants have been transplanted it may be necessary to spray or dust them several times before they are mature. The frequency of treatment will depend upon the weather and the infestation. Occasionally a single spray or dusting, if done thoroughly at the proper time, will be sufficient, but under usual conditions two or three applications are necessary, especially as there are six generations of this insect in a year.

There is absolutely no danger in spraying or dusting cabbage plants with arsenicals until the heads are nearly formed, as the poison disappears within two or three weeks and is completely washed off after heavy showers of rain. When plants are used for household purposes, all that it is necessary to do is to remove the outer leaves and to have the heads thoroughly washed in water.

Spraying was found to be far more effective than dusting, as the powder is liable to be blown off plants during windy weather. When the weather is favourable, dusting should be done in the early part of the morning when there is a dew upon the plants. When spraying is conducted in a garden, the plants should, if possible, first be watered with a garden-hose or a watering-can to enable the dust to stick better, but this method could not be carried out profitably in a large field.

Flowers.—When alyssum, nasturtium, or other flowers are infested, it is safer to spray with arsenate of lead powder, as they are liable to be injured when paris green is used.

Cultural Methods.—Clean cultural methods are strongly recommended. All damaged and discarded cabbage plants and stalks left in a field or garden after the crop has been marketed or used for household purposes should be destroyed, as moths are likely to deposit eggs upon them, and they provide sufficient food to keep the larvae going.

As the mature larvae enter the soil to pupate, large numbers of the chrysalides can be destroyed by cultivating the soil in which cabbage plants are growing.

When to Begin Work.—The best time to begin control work will depend upon the climatic conditions. The insect is generally most troublesome in fields and gardens during autumn and spring, when the weather is usually dry. Whenever the insect is observed to be injuring plants, spraying or dusting should be begun.

SUMMARY.

(1) The larger cabbage moth is distributed throughout the Union of South Africa and is principally a pest of cruciferous plants.
(2) Its increase is considerably influenced by climatic factors, and it flourishes only during the dry parts of the year.
(3) The eggs are deposited in masses on the leaves and stems, and when the larvae emerge they defoliate the plants.
(4) Cabbage plants that have become infested in seed-beds should be sprayed before being planted in fields and gardens.
(5) The caterpillars are readily controlled by spraying with arsenicals or by dusting with paris green and lime.
(6) All old plants that have been discarded in fields or gardens should be destroyed, as they form breeding-places for the insect.

EFFECTS OF SPRAYING CITRUS TREES ON THE COMPOSITION AND FLAVOUR OF THE FRUIT.

By DR. C. F. JURITZ, late Chief of Division of Chemistry.

THE chemical laboratories of the Department of Agriculture have, during the last few years, undertaken to investigate various points relating to the composition of fruit. A few years ago such an investigation was begun in connexion with the ripening of grapes, and a preliminary bulletin, embodying some of the results obtained, has been published.* Certain phases of citrus culture have also been under investigation, incidental to such matters as the fertilizing of the orchards, the maturing of the fruit, and the spraying of the trees. Some results of this study of the chemical conditions affecting citrus cultivation have just been published as a Science Bulletin† of the Department of Agriculture (Division of Chemistry Series No. 60) under the title "Chemical Investigations in regard to Citrus."

The *fertilizing* of citrus plantations will be investigated in the near future by the chemical section of the Potchefstroom School of Agriculture. Potash is known to be a specially important plant food for citrus fruits—more, so, apparently, than for stone fruits; but that fact, and whatever other analogous knowledge we may possess with regard to what the citrus expects from the soil, we owe entirely to work done in the United States and other lands across the seas. It is clear that the whole subject needs to be specially studied under South African conditions.

The *maturing* of the orange presents a number of problems for investigation by the chemist; for instance, the relation between flavour and chemical composition, and how composition may be influenced so as to bring about improvement or deterioration in the flavour.

Some time ago the United States Department of Agriculture printed a bulletin in which there were recorded, amongst analyses of various citrus fruits, results furnished by two varieties of Cuban oranges. One class of orange had a much better flavour than the other. Without an analytical study of these two classes of orange, various opinions might have been hazarded as to the cause of the difference in flavour, and the popular conclusion would probably have attributed this to a greater proportion of sugar in the better-flavoured fruit. Analyses of many oranges showed, however, that this was

* "An Investigation into some Physical and Chemical Changes occurring in Grapes during Ripening." (Division of Chemistry Series No. 31.) Science Bulletin No. 30. Obtainable from the Department of Agriculture. Price 3d. prepaid.

† Science Bulletin No. 40. Obtainable from the Department of Agriculture. Price 3d. prepaid.

not the case—at least not primarily—but that the oranges with the better flavour contained twice as much acid as the others, namely, .77 per cent., as compared with .34 per cent. This point is worth bearing in mind in view of what has since been recorded in South Africa. *Sour* Cuban oranges contained on an average 2.02 per cent. of acid.

The Pretoria laboratory of the Union Division of Chemistry examined six varieties of Navel oranges about seven years ago in order to ascertain whether any influence exerted by various stocks on the fruit could be detected, but the analyses were too few to generalize from.

More recently the chemical staff of the Corner House, Johannesburg, examined some typical Transvaal oranges for the purpose of comparison with Californian standards. According to these investigations, the South African oranges are more juicy and lower in acid and sugar than the Californian standard.

The Science Bulletin now published tabulates the results of 141 analyses of South African oranges performed in the Division's laboratories by way of commencing the detailed investigation alluded to above.

The first stage of the investigation consisted in the examination of forty-five citrus fruits picked during July and early August, and it was the intention to repeat such determinations at successive stages of the ripening process and note the changes in composition undergone; but an urgent need developed for studying a special point, and this side-tracked the main investigation, as will be seen from the sequel.

Reports were received from California alleging that the spraying of orange trees with lead arsenate for false codling-moth was seriously deteriorating the flavour of the fruit, and it seemed advisable forthwith to take up an investigation of the subject from a South African standpoint. The first practical step was the examination in the Capetown laboratory of a dozen Navel oranges from the Bathurst District, Eastern Cape Province—six from sprayed and six from unsprayed trees. The spraying had been carried out at intervals from December to March; in May the Eastern Province Entomologist thought the fruit from the sprayed trees rather insipid, and early in July the twelve oranges were picked for analysis. The analytical results showed the acid in the juice of the fruit from the sprayed trees to average .26 per cent., whilst that in the fruit from the unsprayed trees was over three times as much, averaging .80 per cent. In taste the oranges from the sprayed trees were undoubtedly lacking in flavour when compared with those from the unsprayed trees, but they all realized good prices oversea. It will be generally admitted, however, that flavour should correspond to external appearance, for if it does not do so prices will fall, and the reputation of the orchard, the district, and even the country, may suffer.

Seven weeks later several sprayed oranges from another Bathurst orchard were examined in the Pretoria laboratory, and the results accorded with those just mentioned, the acid-content of the oranges being remarkably low.

Next, oranges from Nelspruit, Transvaal, were examined in the Pretoria laboratory, and the investigation was carried a step further. The Bathurst tests had confirmed the Californian reports to this

extent, that the sprayed trees had been shown to produce fruit inferior in flavour to and lower in acid-content than the oranges from the unsprayed trees; but the question arose, how long will the effects of the spraying continue? Of the Nelspruit oranges, some were from sprayed trees and others from trees that had been sprayed a year earlier. The analyses of these oranges seem to show that the deteriorating effects extended to the second year's crop.

Some months later information was received from the United States that there, too, the effects of spraying had been found to persist for two and even for three seasons, and the still more remarkable observation had been made that the spraying of only one side of a tree affected deleteriously the fruit subsequently produced on *both* sides of that tree.

Last year further investigations were made in the Capetown laboratories, the object being to discriminate, if possible, between the effects of light and heavy spraying. The lead arsenate mixture used was applied to certain trees in the Clumber Orchards, Bathurst, at the rate of 53 oz. per tree and to others at about half that quantity. The flavour of the oranges from the heavily-sprayed trees was distinctly insipid, and the average acidity of the fruit juice was as follows:—

Unsprayed	1.12 %
Lightly sprayed	.49 % *
Heavily sprayed	.18 %

Another curious fact came to light just here, namely, in respect of the percentage of cane sugar (sucrose) contained in the juice from these oranges. The percentages were respectively:—

Unsprayed	4.14 %
Lightly sprayed	3.65 %
Heavily sprayed	1.12 %

About eighty analyses of oranges had been performed to arrive at the conclusions summarized above; the remaining sixty, carried out during the latter half of 1924, were largely devoted to ascertaining how spraying affected *different types* of orange trees. Washington Navel and Valencia Late were taken as types, and thirty samples of the fruit were picked, as nearly as possible simultaneously, in the orchards at Clumber. The average acid-content of the juice is set forth below:—

	Unsprayed.	Lightly Sprayed.	Heavily Sprayed.
Washington Navel	.84	.17	.19
Valencia Late	2.12	not analysed	.47

It appeared, therefore, from these thirty analyses, that, although the acidity of Valencia Late oranges is considerably higher that that of Washington Navel collected at the same time, in both cases spraying produces a reduction to about one-fourth of the normal acid-content.

* Some immature oranges included amongst this batch had a mean acidity of 2·50. They were "sour" and naturally not reckoned in here.

From another Bathurst orchard eighteen oranges were taken simultaneously with those from Clumber, and the average results with respect to acidity were as follows:—

	Unsprayed.	Sprayed.
Washington Navel	.97	.26
Valencia Late	not analysed	1.03

The relatively high figure for the Valencia Late oranges was evidently due to immaturity of some of the fruit. For this reason a final batch of twelve ripe oranges was collected in October last, but, owing to some misunderstanding, the sprayed and the unsprayed oranges were brought from different orchards, and, as there may have been variations between the circumstances of the two orchards, strict comparison becomes impossible, especially as there may be different types of Valencia oranges in the Bathurst District with different normal proportions of acid-contents.

The average results from this last batch of oranges are—

Clumber orchard, unsprayed	.28
Other orchard, sprayed	.26

The low acidity of the unsprayed fruit had not been explained when last season's experiments closed. It may have been due to the effects of spraying during the season before last, or even earlier; or else the oranges may have been approaching over-ripeness. These are, however, points for future investigation.

In the meanwhile it has been sufficiently demonstrated that the arsenical spraying of orange trees lowers the acidity and impairs the flavour of the fruit, while producing no change in external appearance suggestive of this deterioration.

Nurseries in Quarantine at the 1st August, 1925.

Name.	Address.	Cause of Quarantine.	Extent of Quarantine.
J. W. Patrick	Newlands, C.P. ...	Circular Purple Scale	Palms and Aspidistra, all.
W. A. Sturm	Craighall, Johannesburg	Crown-gall and Root-gall Worm	Deciduous, all.
Sunnyside Farm ...	Louis Trichardt ...	Red Scale ...	Citrus, all.
D. J. Conradie & Bros.	Robertson, C.P. ...	Red Scale ...	Citrus, all.
A. S. Strydom & Co. ...	Krakeel River ...	Woolly Aphis ...	Deciduous, part.
Craighall Estate Nursery	Craighall, Johannesburg	Pernicious Scale...	Deciduous, all.
G. J. Labuschagne ...	Groot Marico ...	Red Scale ...	Citrus, all.
Distributors Co., Ltd.	Johannesburg ...	Pernicious Scale...	Deciduous, part.

WEEDS OF SOUTH AFRICA.

By K. A. LANSDELL, Botanical Assistant, Division of Botany, Pretoria.

XVI.

[Like other countries, South Africa is awaking to the importance of suppressing its noxious weeds, which, owing to the alarming rapidity of their spread in recent years, are becoming increasingly dangerous to our pasturage, wool, and other agricultural pursuits. While much has been done in the past to place the farmer in a position to recognize and cope with the danger, the problem grows in seriousness, and the time has arrived when all information regarding the noxious weeds found in the Union should be gathered into one publication for the use of the farmer, the student, and the general public. This work has now been undertaken by the Division of Botany, the opening contribution, continued hereunder, appearing in our April, 1921, number. The publication, which includes an illustrated glossary on the morphology of weeds, is the first of its kind in South Africa, and will continue to appear in serial form in the *Journal*. Thereafter, the series will be reprinted in bulletin form, with the addition of a coloured plate illustrating each weed dealt with.—EDITOR.]

Weed No. 11.

"THE RUSSIAN TUMBLE WEED," *SALSOLA KALI*.
Order *Chenopodiaceae*.

THE "Russian Tumble Weed," botanically known as *Salsola kali*, G. F. W. Mey, is a native of Russia and western Asia. It was probably introduced into South Africa in forage during the Boer war. It is found chiefly in the coastal areas, but also in land where the soil is impregnated with salt. In South Africa it is prevalent in the southern and eastern districts of the Cape Province. The plant produces seed in abundance, and it is stated that one plant may produce from ten to thirty thousand seeds, which retain their vitality in the soil for several seasons.

The "seed" is very small, reddish in colour, irregular in shape, but somewhat like a flattened top, and is held in position by fine tufts of coiled hairs at the base of the persistent calyx (Plate II, Fig 5). The embryo is spirally coiled (Plate II, Figs. 1 and 2).

The "seeds" may be disseminated in various ways:—

(1) They are surrounded by a papery calyx which enables them to be blown about by the wind.

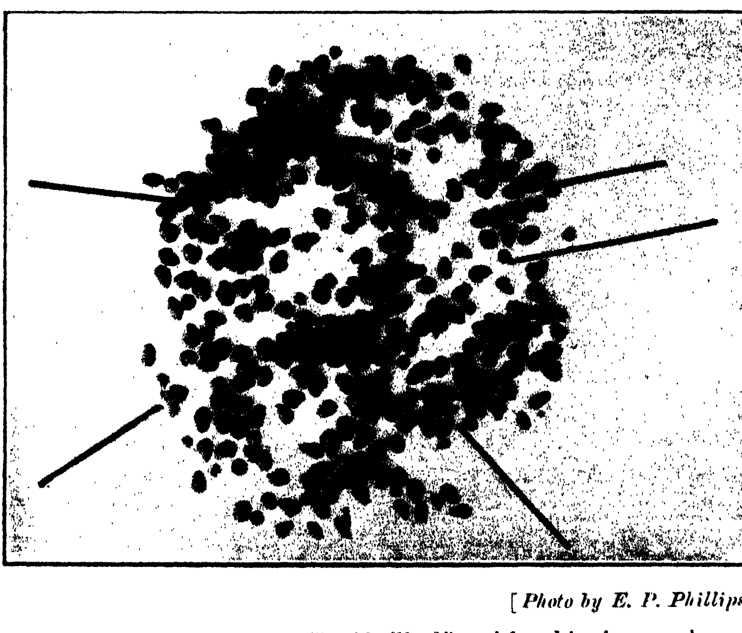
(2) They are carried down streams by flood waters and deposited on the banks of rivers, where they germinate.

(3) As the plants grow in cultivated lands, the seed may be harvested with the crop (Plate I).

(4) The plant when broken from its hold on the soil is blown about by the wind and the ripe seeds are shaken loose, and may thus be spread over a wide area.

In 1920, germination experiments were carried out at the Division of Botany, Pretoria, with the following results:—

Soil Treatment.	Number of Seeds Planted.	Date Planted.	Germination.
Not treated	50	21st July, 1920	2 per cent.
Treated with a dressing of salt...	50	22nd August, 1921	20 „
White River Sand, not treated...	50	24th July, 1922	10 „



[*Photo by E. P. Phillips.*

PLATE I.—The "Russian Tumble Weed" seed found in clover seed.

During germination the embryo stretches and at the same time pushes the radicle out of the seed-coat (Plate II, Fig. 2). The second day after germination the seed-coat is thrown off and the cotyledons are exposed (Plate I, Fig. 3). The cotyledons are pale green in colour, circular in cross-section, and the seedlings resemble young grass-shoots. The seedlings were planted out in the laboratory grounds, but succumbed before attaining maturity.

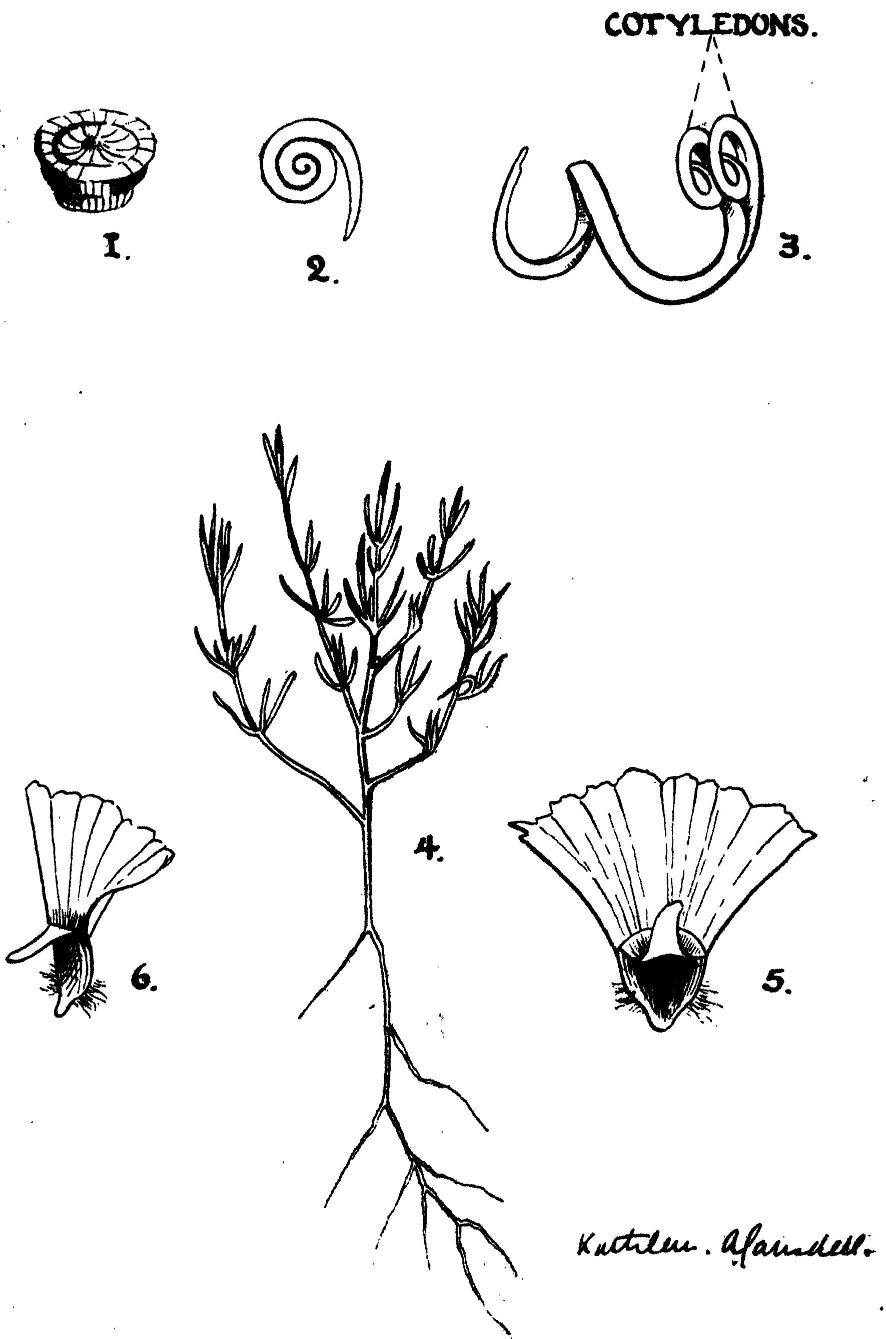


PLATE II.—Fig. 1.—Seed enlarged. Fig. 2.—Embryo. Fig. 3.—Cotyledons. Fig. 4.—Seedling. Fig. 5.—Win ed calyx lobe showing tip and hairs (front view). Fig. 6.—Calyx lobe (side view).

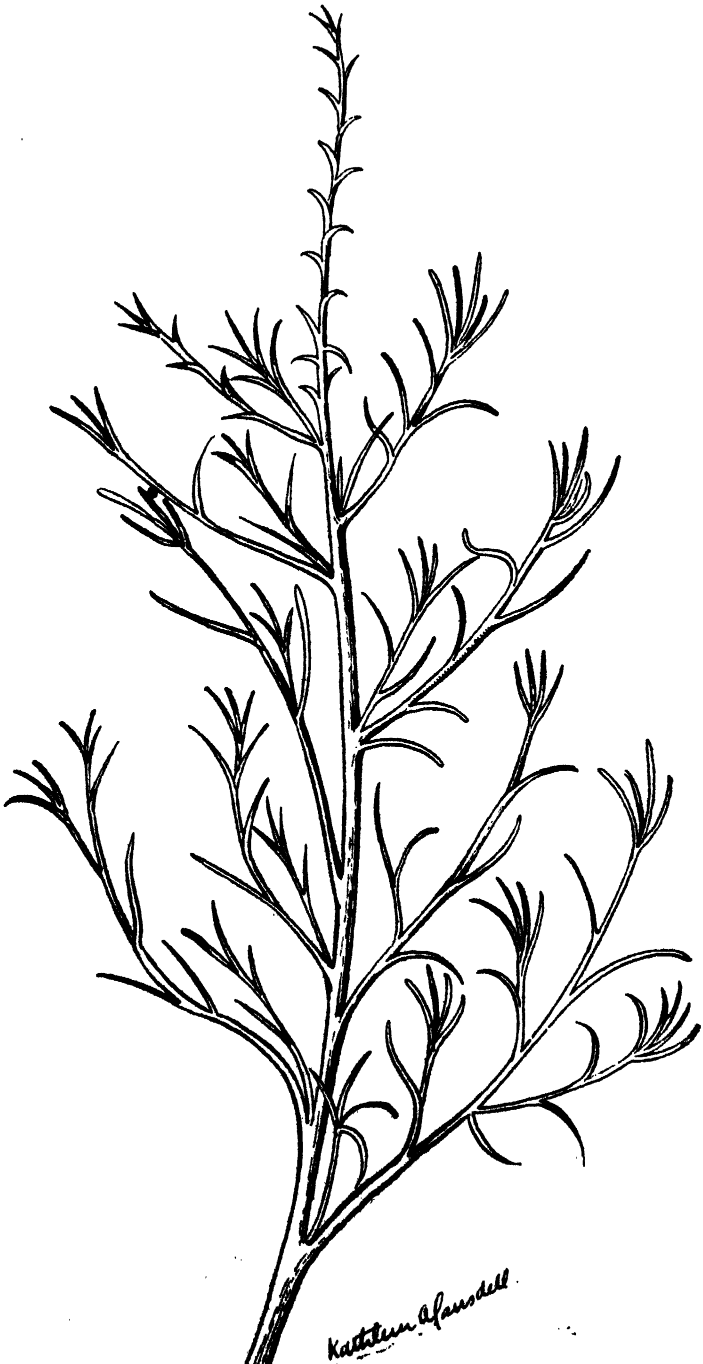


PLATE III.—Portion of young plant.

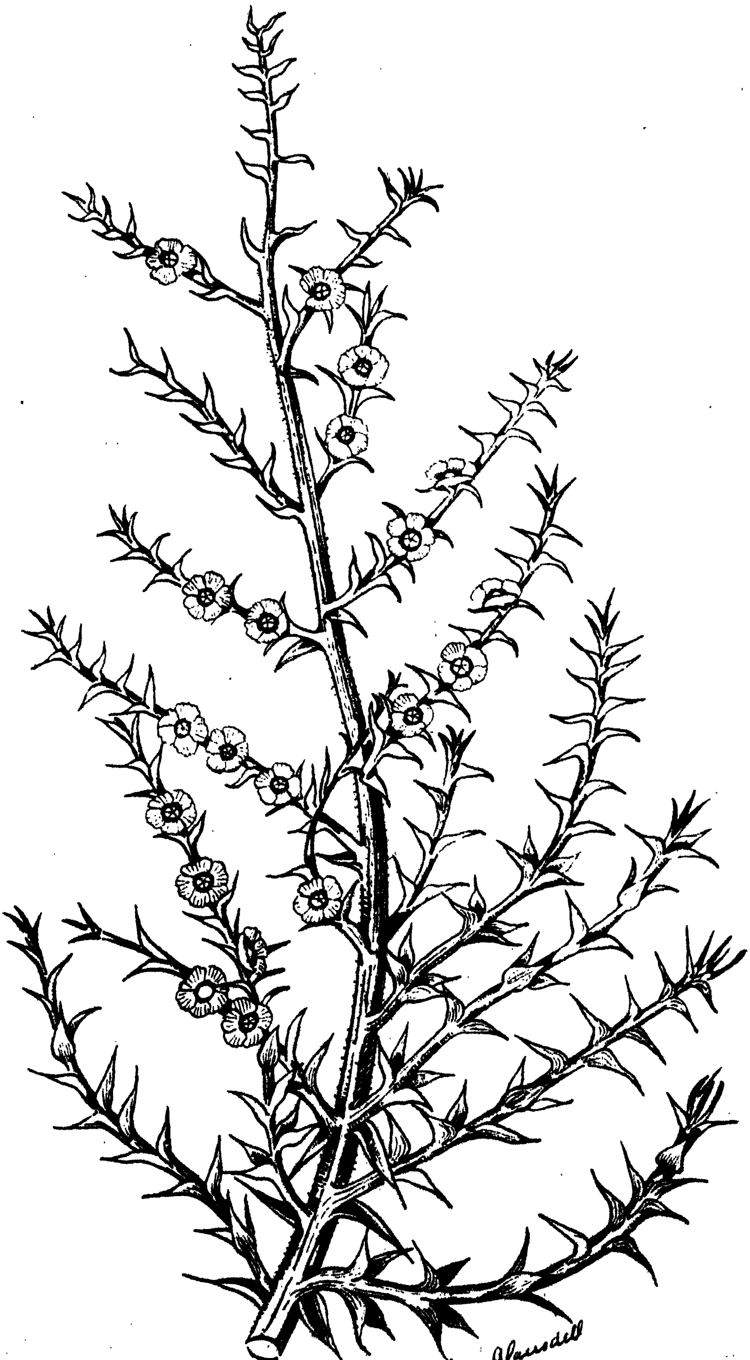


PLATE IV.—Portion of mature plant.

The young stalks are tender and succulent, and at this stage of growth the plant is said to be a good feed which cattle and sheep relish (Plate III).

The "Russian Tumble Weed" is a brittle succulent annual, of a pale bluish-green colour, with somewhat angular furrowed stems, smooth or slightly pubescent, diffusely branched from the base, spherical in the mature form (Plate VII). The young leaves are tender and succulent, about 1-2 inches long, narrow and cylindric. As the plant matures it changes its character; the stem becomes hard and woody, ridged, and streaked with dark green lines (Plate IV). The first leaves fall away, and those of the later growth are not more than a half-inch long and are awl-shaped, nearly cylindric, with spiny tips (Plate IV.)

The flowers are solitary in the axils of the leaves, very small, greenish white or often pink; the flower has no petals, but a calyx of

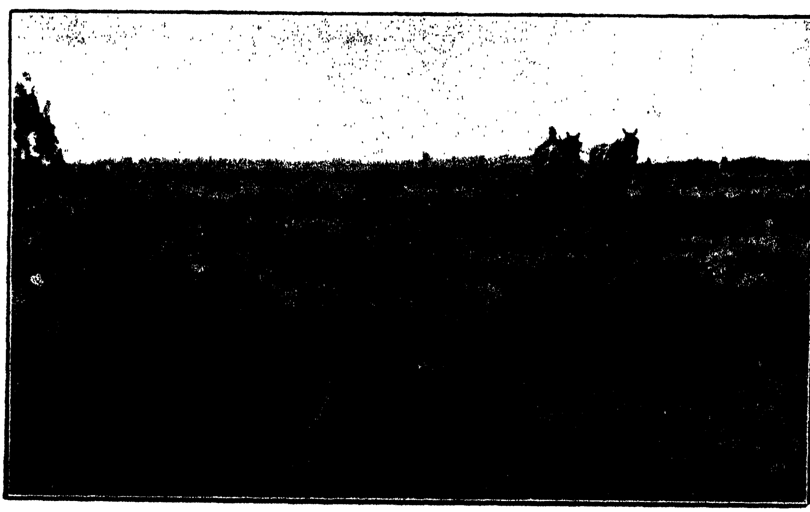


PLATE V.—Russian Thistle (*Salsola kali* var. *tenuifolia*) as it occurs in the San Joaquin Valley. Note adjacent grain fields and infestations beyond the fence caused by not keeping the waste lands in the foreground clean. (U.S. Dept. Agri.) "Weeds of California," Vol. XI.

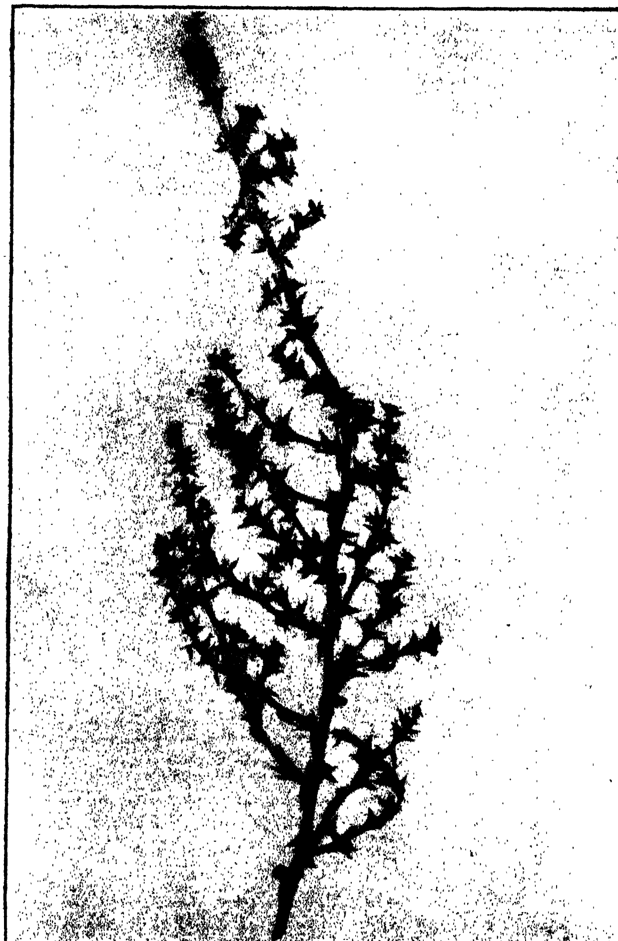
five divisions (sepals), with their tips converging over the centre of the flower, is present; each sepal bears a veiny wing on its back, and the five wings meet to form a broad papery margin of a light straw colour with frayed edges (Plate II, Figs. 5 and 6). There are five stamens; the ovary is covered by the ascending tips of the sepals; only the styles protrude.

The Division of Chemistry submitted the following report on an analysis of the plant:—

"It is evident that sodium and potassium in the ash of this plant are present as chlorides chiefly. The amount of carbonates present corresponds to 6.8 per cent. (of the ash), calculated as sodium carbonate. Of course, all the carbonate is not necessarily present as sodium carbonate; some potassium carbonate is also present. The

figure 6.8 per cent. as sodium carbonate is, however, a measure of the value of the ash for soapmaking. This compares very unfavourably with the ash of certain mesembrianthema (loog-as), and in my opinion Russian Thistle is of no value from this point of view."

Eradications.—As the plant is an annual, eradication should be attempted, if possible, by hand-pulling or hoe-chipping before the



[*Photo by H. King.*

PLATE VI.—Portion of mature plant growing in the Van Rhynsdorp District, Cape Province.

plants have had time to ripen their seeds, so as to prevent the production of seed. In newly infested lands young seedlings may be ploughed under.

The "Russian Tumble Weed" is a proclaimed noxious weed in certain divisional and municipal areas of the Cape Province.

Table showing the districts and municipalities in which "Russian Tumble Weed" is proclaimed noxious:—

Divisional Council Areas.	Municipalities.
Aliwal North.	Aliwal North.
Bedford.	Bedford.
Cradock.	Capetown.
Graaff-Reinet.	Cradock.
Molteno.	Somerset East.
	Steytlerville.

[*Photo by H. King.*

PLATE VII.—Mature plant of "The Russian Tumble Weed," grown at the Botanical Laboratories, Pretoria.

Summary of information for use in the recognition of the weed, dissemination, and eradication:—

Vernacular name ...	The Russian Tumble Weed.
Scientific name ...	*Salsoli kali.*
Duration	Annual.
Flower	Minute, surrounded by a papery calyx.
Leaf...	Awl-shaped, pungent.
"Seed"	Small, reddish in colour, irregular in shape. resembling a top.
Habitat	Usually brak lands.
Dissemination ...	Impure seed, fodder, wind, flood waters.
Eradication... ...	Never allow the plants to develop seed. In newly infested lands the young plants may be ploughed under.

CLEAN MILK, AND HOW TO PRODUCE IT.

The Dangers of Impurity.

By W. A. MURRAY, M.B., D.P.H., Assistant Health Officer for the Union.

COW'S MILK is the most important and most universal of all human foodstuffs. Not only does it enter into the composition of many common articles of diet, but a large proportion of European babies and children are entirely dependent upon it for their nourishment. But milk is the most easily contaminated and, therefore, the most dangerous article of human diet. It forms an ideal medium for the growth and multiplication of many forms of disease germs, such as those that cause enteric fever, dysentery, diarrhœa, tuberculosis, etc., and is able to convey these diseases to human beings with ill-results.

The death-rate of European infants in South Africa is appallingly high, and when the underlying causes are investigated, it is found that a very large proportion of them may be traced to the feeding of infants with impure milk, which sets up fatal bowel diseases.

Many parents who have to use cow's milk for their babies try to ensure its freedom from disease by boiling or pasteurizing the raw milk. This practice, however, destroys some very delicate and important properties of the milk, the absence of which in the course of time leads to rickets and other evidence of weakened resistance to the attacks of disease germs. There is no doubt that boiling and pasteurization very seriously diminish the nutritive and protective value of milk. Every effort should therefore be made to avoid the necessity for the boiling of milk. When one watches the average process of milking, the methods of storage, handling, and distribution of cow's milk in South Africa, it is astonishing how easily and in how many ways the contamination mentioned above can and does occur. It occurs through the addition of *dust* from the cowshed or kraals, *hairs* or *shreds of cow-dung* from the cow, *dirt or sweat* from the milker's hands or clothing, *filth and germs* from the feet or mouths or excrement of flies as well as from *bacteria* from unsterilized utensils, bottles, etc., used for milking, or for storing or distributing the milk. Such dirt or bacteria in warm milk rapidly set up fermentative processes, which turn the milk sour and thick, and may cause very serious bowel diseases in those who consume it.

Yet such contamination occurs daily in most of our so-called "dairies," especially those on farms, in villages, and in the smaller towns. On the other hand, inspection of an up-to-date dairy (and there are, fortunately, a good many to be found in our cities and large towns) reveals the fact that all this contamination can be avoided, and that the production of "pure" milk, and its safe delivery to the consumer, is possible.

The ideal, therefore, of every milk-seller and dairyman should be to obtain pure milk from the cow and to deliver it pure to his

customers. It is undeniable that over 80 per cent. of the milk sold in this country is dangerously impure.

The following hints are intended to assist dairymen and cow-keepers to attain this necessary and practicable ideal. It is also intended to set a standard which every municipality should adopt as a minimum for all dairies and milkshops within its area and jurisdiction.

ESSENTIALS IN PURE MILK SUPPLY.

(1) *Buildings.*—In considering how best to protect milk from dust, dirt, and disease germs, it is obvious that in the first place proper buildings are of great importance. Every dairy should consist of a properly constructed and equipped cowshed, milkroom, and washing-place, and efficient sterilizing equipment.

A well-built cowshed or cowstable is essential. Milking done in the open air or in a kraal makes cleanliness quite impossible owing to the pulverized dung and dust always present. The most important part of the cowshed is its floor, next come the walls, and then the roof. The floor *must* be of impervious material (fluted concrete or well-laid clinker-bricks or flags laid in cement), slightly sloped and channelled to permit easy cleaning and flushing with water. An ample supply of clean water should be laid on in the cowshed to provide for rapid and thorough flushing once or twice a day. The floor must be scrupulously cleaned as soon as the cows have been let out each day and the manure removed to a distance from the cowshed and milkroom, so as to avoid attracting flies to these buildings. The floor-washings should be conveyed by the floor-channels to a large pail or drum standing in an outside sump (catch-pit), whence they are at once removed to a suitable disposal site at a distance.

The walls of the cowshed should be solid (good brick faced with smooth cement plaster to facilitate washing down). The usual corrugated iron walls with woodwork inside are almost impossible to keep clean, and favour the collection of dried dung and dust, especially on the woodwork. Windows should preferably be high up to avoid cold draughts on the cows in winter. Concrete mangers are better than wooden or iron ones, as the latter rot or rust through, giving rise to collections of damp food beneath, which attract flies and cause stench.

(2) *Milkroom.*—A properly built and furnished milkroom is also essential. It should be a separate building, not part of either the cowshed or the dwelling-house (risk of infectious disease, lack of ventilation, etc.), yet not more than 10 to 15 yards from the cowshed, in order to encourage immediate removal of every full pail to the milk-room. The milkroom must be built with an eye to coolness (e.g. of stone or brick with a thatched roof), must have a sloped concrete floor, a good ceiling, and have both door and window *effectively* fly-screened at all times: a flimsy screen-door will soon warp and become defective and let in more flies than it keeps out. A supply of pure cool water should be laid on in the milkroom, to keep the floor damp and cool and to operate the milk-cooler, which is a most important item in the equipment of the milkroom. The temperature of milk when drawn from the cow is about 100° F., and unless it is rapidly cooled down to about 50° F. any bacteria which have

found their way into the milk will multiply fast and set up fermentation and souring in less than twenty-four hours. Cooled milk keeps sweet for a much longer time.

The milkroom should contain a well-made table or broad bench for the pans, clean pails and cans, and a drying-rack for bottles.

(3) *Washing-place.*—A separate washing-place is a great advantage. A small concrete platform, sloped to a drain or catch-pit, with three corrugated iron walls and a roof, and fitted with a water-tap, would suffice. Here the used pails, pans, cans, and bottles are thoroughly washed each day after use, before the milk residue has had time to dry or become sour. First rinse out with cold water, then wash with a stiff brush in hot water containing washing soda, then rinse again in cold water. Sun the utensils to get rid of smell. It should not be necessary to mention, but unfortunately is, that the use of sand for scouring out pans, etc., and for washing out bottles, is utterly inadmissable in a modern dairy.

THE CARE OF UTENSILS.

The sterilization of these vessels is an *absolute essential.* Most municipal dairy by-laws specify "thorough sterilization by means of steam or boiling water," but only the very best dairies are found to comply with this requirement. A practical method, which is less expensive than the installation of a proper steam boiler, is to fit up a strong 50-gallon iron tank over a fireplace and to fix a strong wire grid across the inside about half-way down. Fill the tank three-quarters full with water and light the fire when milking commences: by the time the utensils need to be washed there is plenty of hot water available. After the washing, the utensils are arranged upon the inside grid, which is now exposed, and are sterilized in the steam from below in fifteen or twenty minutes; they are then taken out and left to drain upside down in the milkroom. The opening in the top of the tank should, of course, be sufficiently large to admit large milk-pans as well as the cans, etc.

As to the types of utensils admissible, the use of whisky bottles for milk retail is utterly condemned, because of the difficulty to clean both bottle and cork. Besides this, their use is illegal in South Africa under the Assize Act of 1922. On the other hand, the wide-mouthed Canadian bottles are easily cleaned and sterilized and are of a standard size: these should always be used in delivering small quantities of milk (less than one gallon) to a customer. Quantities of one or more gallons should be delivered in sealed or locked steel cans of the appropriate size.

Seamless metal cans should always be used in preference to tin pails, the use of which is inadmissable on account of cracks in the metal and imperfect fitting of lids, due to want of rigidity. Metal cans which can be locked, for each customer, are preferable to the cans with taps or with a "dipper," both of which types allow gross contamination of the milk inside.

Milking-pails should also be of seamless steel and should have three-quarters of the top closed in with a metal cover, which will keep out most of the dust, dirt, hairs, etc., that would otherwise fall into the pail during milking. Where these special partly-covered pails are not procurable, the same object may be partly attained by

carefully tying a double thickness of butter muslin (or a single thickness of washed calico) loosely over the top of the pail, whereby the dirt from the exterior of the cow will be strained out.

PREVENTING POLLUTION.

A careful consideration of all the factors concerned in the production of milk will reveal the many dangers and sources of pollution and also afford a key to their prevention.

First of all, the *health of the cow* is an important consideration. Has each cow in the herd been proved, by the tuberculin test, to be free of that dread scourge of mankind—tuberculosis? Is the udder entirely healthy? Or is one of its quarters tender or inflamed or producing purulent or bloody milk? Is any teat cracked or swollen? If so, the milk from such a cow must be kept separate until the fault is remedied.

Next, the cow's coat always has dust, flakes of cow-dung, loose hairs, scales, and bacteria loosely attached to it. Its flanks and udder, therefore, need to be groomed with a stiff brush a little while before milking.

Then the udder and teats require special washing and treatment just before the cow is milked. The long hairs of the udder should be occasionally clipped short. The udder and teats must be carefully washed with warm water just before milking and wiped with a clean dry cloth. A little pure vaseline should be rubbed on each teat to facilitate withdrawing of the milk (wetting of the milker's fingers in the milk-pail while milking is a filthy habit which should be sternly suppressed).

Then there is the important matter of *the milker*. Is he a native? Is he healthy? Is he free from infectious or communicable disease? It is most certainly the duty of every dairyman and milk-seller to ensure that his milkers are not suffering from any disease such as tuberculosis, syphilis, or bowel disease, or are not "carriers" of enteric or diphtheria.

Is the milker clean in his person and clothing? What facilities has he for washing his person? Does he wash his hands immediately before milking? For the latter purpose, a basin of clean warm water, soap, and a clean dry towel should always be provided. He should wear a clean overall while milking. Unless these necessary precautions are carefully attended to *every day*, the dairyman is not doing his duty to ensure a pure milk supply to his customers: on the contrary, *he is ensuring a contaminated supply.*

Dairymen often strongly object to the enforcement by local authorities of these essential sanitary principles on the score of increased trouble and expense. It must be remembered, however, that a public "sanitary conscience" is slowly but very surely growing up, which will no longer tolerate slovenly, insanitary, and filthy methods of handling of foodstuffs. Thus the public generally, as well as the Public Health Department, are backing up all municipalities when these insist that modern and sanitary methods of milk production and handling must be carried out in their areas.

In some centres the municipalities place their medical officers of health at the disposal of their dairymen for free periodical examination of milkers and milk-boys, whether native or European. This excellent measure should be generally adopted by the local authorities.

DROUGHT-RESISTANT FODDERS.

By H. W. TURPIN, B.Sc., M.Sc., Ph.D., and I. J. SMUTS, B.Sc., Grootfontein School of Agriculture, Middelburg, Cape.

GOOD GRAZING is one of the most economical factors in the production of milk, meat, and wool, and should be employed to the full to make production as cheap as possible. The paddocking of farms and a properly controlled system of grazing are therefore of great importance; the Drought Investigation Commission estimates the value of the resultant increased production of small stock from a perfect system of paddocking and proper grazing at the high figure of £13,000,000 annually. But paddocking can increase the carrying capacity of a farm up to a certain point only. Increase above this point can result only from the production and economical use of feeds for farm animals. To make the best use of such feed, they must be fed when stock are in the greatest need thereof—usually during periods of drought and the dry season of the year. Feeding for production on anything like an intensive scale can follow only when a sufficient supply of feed is assured. South African climatic conditions are so uncertain, however, that over a great part of the country the usual forage crops can be grown only under irrigation; and in the Karroo and other dry parts of South Africa water for irrigation is so scarce that costly dams must be constructed (and even then the water and soil are often brak), so that the production of drought-resistant plants to provide a sure source of feed for farm animals is of great importance.

The plants, discussed in this paper, suitable for feeding and extremely drought-resistant, are the cactus, aloe (American agave, or garingboom), and the saltbush. Their importance will be appreciated in the light of the following considerations:—

(1) Periods of drought, often protracted, cause great loss through (*a*) hunger; (*b*) thirst; and possibly through (*c*) lack of green food, resulting in a deficiency of the accessory food factors known as vitamins, which are especially necessary in the case of milk-producing and young animals.

(2) Drought-resistant plants are able (*a*) to make very efficient use of water, when available, by storing it in their thick leaves, and can then remain alive and succulent when little or no water can be drawn from the soil—for example, the cactus and the aloe; and (*b*) to draw water from a great depth of soil, and in that way become somewhat independent of surface water—for example, the saltbush and the indigenous Karroo bushes which have deep penetrating tap-roots. Thus the drought-hardy plants are capable of remaining green and succulent during periods of dry weather, and in this way can provide animals with a supply of the essential vitamins, water, and food materials.

(3) It is characteristic of many of our Karroo plants that they have fleshy, succulent leaves, which enable an animal to obtain a

portion, at any rate, of the water necessary for life. The water-content of the aloe and cactus may vary from 80 per cent. to over 90 per cent., while the saltbush contains (in the leaves, of course) only slightly less water, from 70 to 80 per cent. The need of succulence in the ration of an animal is emphasized, not only because it has such a beneficial effect on their milk production, but because from the green succulent material they eat, animals get the vitamins so essential for growth and life. The sheep-farmer will realize that succulence in the ration is most necessary during the lambing season, so that the lamb will be provided with sufficient milk well supplied with the necessary vitamins obtained by the ewe from the green, succulent feed. Now, it often happens that the lambing season synchronizes with a period of protracted drought, when it is hardly possible to provide lambing ewes with green, succulent material, such as rape. During such times, a plantation of drought-resistant

PLATE I.—Five-year-old Spineless Cactus Plantation, to which stock had access occasionally, showing the damage done when not fenced in. (Compare Plate II.)

plants will be invaluable to the farmer. A report by Mr. H. A. Mellé on certain feeding trials carried out at Pretoria by the Division of Botany, states, *inter alia*, "Judging from the results of this experiment, one is led to believe that one of the most essential requirements for our stock, which are dependent on dry grass during the winter months to keep them in a good, thriving condition, is a succulent feed. We are able to meet this both cheaply and efficiently with spineless cactus. The stock used in this experiment have been fed on grass and cactus throughout the winter and are in good, thriving condition, and some of the beef grades are in prime condition. On our dry-land station all our animals, including pigs and sheep, get a daily ration of cactus and are all in a thriving condition."

(4) Unless an animal will take readily to a feed, or can be made to acquire a liking for it, the feed will be of little value. Fortunately,

the majority of farm animals will eat cactus, aloe, and saltbush. In some instances stock take a time before they get used to these fodders; farm animals also have their fads, even where the most palatable feeds like green oats and mealie grain are concerned. In the experiment referred to above, the oxen mostly preferred the cactus leaves to silage. At Grootfontein also no difficulty is experienced in getting sheep and cattle to eat large quantities of cactus and aloe leaves. Cactus and aloe leaves (cut up) form, of course, a large part of the ration of our ostriches. Many of our leading farmers include these plants in the rations of their animals, which shows that animals do not need much coaxing to take to them. Indeed, it is the palatability of spineless cactus that accounts for the difficulty experienced in establishing this plant in plantations which are not fenced in, for stock take to it readily and so destroy the young plants.

(5) In their high water-content, these plants are not so very different to crops such as mangel-wurzels and maize for silage. The

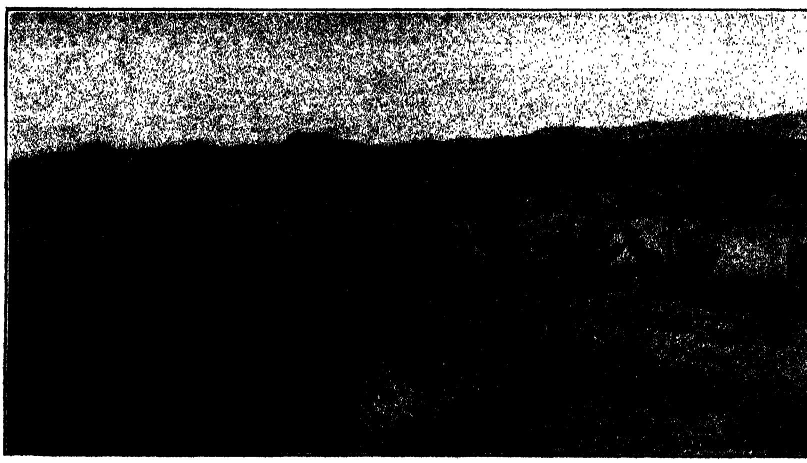


PLATE II.—Three-year-old Spineless Cactus Plantation, showing vigorous growth when the plantation is fenced in.

following table (compiled from "Feeds and Feeding," by Henry and Morrison) gives the amount of dry material and digestible nutrients in pounds for every 100 lb. of the undermentioned crops:—

TABLE I.

Feed.	Dry Material.	Digestible Protein.	Digestible Carbohydrates.	Digestible Fat.
Lucerne-hay	91·4	10·6	39·0	0·9
Prickly Pear	10·4	0·4	5·8	0·1
Old-man Saltbush	23·3	2·8	5·9	0.2
Creeping Saltbush	24·3	2·9	6·6	0·1
Maize Silage	26·3	1·1	15·0	0·7
Mangel Wurzels...	9·4	0·8	6·4	0·1
Rape	16·7	2·6	10·0	0·3
Wheat (Grazing)	27·4	2·8	15·1	0·6

These feeds are arranged in the order of the digestibility of their dry material in the following table:—

TABLE II.

Feed.	Percentage of Dry Material Digestible.
Mangels	79·8 per cent.
Rape	79·6 „
Wheat	70·0 „
Silage (Maize)	66·5 „
Prickly Pear	61·5 „
Lucerne-hay	56·4 „
Saltbush (Old-man and Creeping)	40·0 „

Thus, although digestibility and palatability are two great factors in deciding which feeds have to be grown for stock, quality and yield are of even greater importance, two points which will be returned to later. This table shows, however, that, although mangels and rape are far more digestible than prickly pear, the latter is still sufficiently digestible to warrant its being fed to stock, and is in any event much more digestible than saltbush and shows a digestibility of very nearly that of maize.

(6) As to the value of prickly pear as a succulent material fed in conjunction with dry feeds, the following table, the result of a feeding experiment carried out at Grootfontein by Messrs. Arthur Stead and E. N. S. Warren, shows the amount of feed, mostly prickly pear, given to three-year-old veld hamels and the changes in their live-weights:—

TABLE III.

No. of Days.	Ration.	Changes in Live Weight.
1-25	10·76 lb. prickly pear and ¾ lb. lucerne ...	Weight still the same.
26-31	15·9 lb. prickly pear and nothing more ...	Weight decreasing.
32-41	12·85 lb. prickly pear and ½ lb. straw ...	Weight decreasing.
42-87	14 lb. prickly pear and nothing more	Weight decreasing.
88-90	2 lb. lucerne-hay	Weight decreasing.
91-112	15 lb. prickly pear and nothing more	Weight increasing.
113-117	5·5 lb. prickly pear and 1 lb. lucerne-hay ...	Weight increasing.
118-196	13 lb. prickly pear and nothing more	Weight decreasing.

At this point the hamels were split up into two lots:—

(a) *The Five Strongest.*

No. of Days.	Ration.	Changes in Live Weight.
197-260	12·5 lb. prickly pear and nothing more ...	Weight decreasing.
261-267	10 lb. prickly pear and nothing more	Weight decreasing.

(b) *The Four Weakest.*

No. of Days.	Ration.	Changes in Live Weight.
197-260	10·5 lb. prickly pear and 3 ounces lucerne-hay	Weight increasing.
261-267	12·6 lb. prickly pear and 6 ounces lucerne-hay	Weight increasing.

Increase per head as result of feeding 3 oz. lucerne-hay daily for sixty-four days and 6 oz. for seven days, 3 lb.

Throughout this experiment the animals received no water for drinking purposes; in fact, sheep had been kept for 525 days without water for drinking purposes; all the water they required was provided in the form of prickly-pear leaf. From this it is concluded that sheep may be kept alive without water indefinitely if provided with succulence. Another fact brought out by this experiment is, that prickly pear alone will keep full-grown sheep in good condition alive for long periods, probably for 200 days or more, but that it will not maintain sheep. The reason why prickly pear cannot maintain sheep (and probably any other animl) is evident. The body of the sheep, like that of any other animal, requires for maintenance a minimum of the essential food constituents, viz., water mineral matter, protein, carbohydrates, fats, and vitamins. Now, the relative quantities of these that a particular kind of plant will contain is a fairly definite amount, and this amount may be sufficient to maintain the animal, or too little. Unfortunately, it is the case with prickly pear, and perhaps aloe as well, that it does not contain sufficient of all the essential food constituents, at any rate, to maintain a sheep. Maintenance tables, compiled by Henry and Morrison, two American authorities on nutrition, give the digestible amount of the various food constituents required to maintain a 100-lb. ewe producing milk, as follows:—

TABLE IV.

Dry Material.	Protein.	Carbohydrates.	Fats.
2·5 lb.	0·3 lb.	1·5 lb.	0·05 lb.

The amount of dry matter, provided that sufficient bulk is maintained, is a comparatively constant one; if the feed is too concentrated it will not distend the animal's stomach, and if it is too bulky the animal will not be able to take sufficient to provide for its wants. Now, if a ewe is fed prickly pear alone and it is desired to supply her with a sufficiency of dry matter, she will have to be given daily rations of 25 lb. at least, which is probably more than such an animal will take in ordinary circumstances, for the simple reason that the animal's stomach is too small to take this amount. But even if the ewe did take that amount, then, according to Table I, she has only taken 0.1 lb. digestible protein, or about one-third of the amount required for maintenance, because for that purpose she requires 0.3 lb. (Table IV). Not only this; 25 lb. prickly pear per day will provide the animal with less than the full amount of digestible carbohydrates necessary for maintenance. If she is now allowed to take as much as she wants, when she will take average daily quantities of about 15 lb. perhaps, she only gets sufficient to supply about one-sixth of her protein requirement and half her requirements for carbohydrates. The more such an animal partakes of prickly pear, the better she will be able to provide for her need for carbohydrates, but there will always be a deficiency of protein, even though she takes as much as 50 lb. per day, which evidently is impossible. This deficiency of protein can be rectified only by feeding a feed rich in protein, like lucerne-hay, in conjunction with prickly

pear, and the longer the period that stock dependent to a greater or less extent on prickly pear are to be kept alive, the more imperative it is that this deficiency of protein be supplied. And it is especially of importance in cases where ewes have to support lambs (lambs are dependent on the ewes not only after but also before birth) that such ewes be supplied with a sufficiency of protein. The balancing up of the prickly pear or aloe ration with protein-rich feeds is indispensable for the lambing ewe, and if the veld does not provide such feeds, the farmer must do so by feeding lucerne-hay or something else. Not only must the prickly-pear ration, whether for maintenance or production, be supplemented with the necessary protein, but as prickly pear contains about 90 per cent. water, the animal will not find it an easy matter to take sufficient dry matter to maintain herself and perhaps a lamb as well. For this reason, the supplementing of cactus with a feed containing much dry matter (substance) will be of great benefit. These considerations explain why the addition of

PLATE III.—The effect of Manure on the Growth of Cactus. Left: Two plants growing on a manured spot. Right: Two unmanured plants in the same row.

lucerne-hay to the prickly-pear ration in the Grootfontein feeding experiment had such a beneficial effect on the weight of the hamels. It may be mentioned here that for a 100-lb. ewe producing milk, 12½ lb. prickly pear, plus 2½ lb. lucerne-hay, will be in the nature of a maintenance ration and, although this ration cannot be recommended for any great length of time, it will nevertheless be of great use during periods of drought or during the winter.

Notwithstanding that prickly pear is low in protein and does not contain the adequate amount of dry matter, it is nevertheless of great value as a succulent supplement to a dry ration. During periods of scarcity it provides sufficient feed to keep stock alive for a considerable time and also all the required water, the absence of which, during periods of drought, is often the cause of death of stock. In this connexion, the statement made by Mr. T. J. de Kock (Edenburg) to the Drought Investigation Commission in 1920 may be of interest: "In 1912 I lost through drought 400 sheep, 30 cattle, and 12 foals. I then started with prickly pear as a feed, with the result that I suffered practically no further loss of stock."

(7) The value of prickly pear becomes especially apparent when its yield is taken into consideration. But here also, as with all crops, yield depends on the variety grown, the age of the plantation, and the soil moisture and fertility. As far as variety is concerned, Fusicaulis has, under most climatic conditions, been found to be one of the best, if not the best. At Grootfontein it has been observed that where a row of plants happened to pass through a spot where manure had been scattered (Plate III), the yield of ten plants in two seasons was 248 leaves, as against 144 in the same row where there was no manure, and the leaves in the latter instance were smaller. Also, it has been found by trial that the total leaf production for several rows of different varieties was 440 where the plants were irrigated three times on poor soil, while under the same conditions without irrigation, the yield was 375, and in the latter case the leaves were smaller and more shrunken. The prickly pear is, however, a plant which gives exceptionally high yields under conditions not very suitable for plant growth.

Under average conditions it would be advisable to plant about 1,000 plants per acre, and as the leaf will weigh from 1 to 1½ lb., the yield will be as follows:—

TABLE V.

	Leaves per Plant.	Tons per Acre.
1st year	4 to 5	2 to 3
2nd year	10 „ 20	5 „ 15
3rd year	20 „ 40	10 „ 30
4th year	40 „ 80	20 „ 60
5th year and after	80 „ 160	40 „ 120

It can, therefore, reasonably be expected that a mature plantation five years or more old will give a yield of 80 tons to the acre. The most favourable conditions only will permit of yields of 30 tons of maize silage, while 30 tons of roots, for example mangels, per acre will require much work and water, while lucerne under irrigation will yield about 5 tons only. These yields per acre of prickly pear, maize, mangels, and lucerne, expressed in terms of digestible nutrients (that is, that part of the food material actually absorbed into the blood-stream), are compared in the following table:—

TABLE VI.

Crop.	Yield per Acre in Tons.	Quantity Digestible Nutrients Produced per Acre in Tons.
Prickly Pear	80	5
Maize (silage)	25	4·2
Mangels	25	3·7
Lucerne-hay	5	2·5

The quality of these nutrients is of importance. That produced by prickly pear, maize, and mangels is mainly of the same nature, i.e. all three show a deficiency of protein, while the starches and sugars are present in fair quantities. Lucerne, however, is a

legume and produces much protein, so that it must be placed in a class by itself, and because of the relative abundance of protein, can be fed with advantage in conjunction with the other three, which all show a deficiency of protein. But of the three—prickly pear, maize, and mangels—prickly pear gives, in spite of its high water-content, the greatest yield of digestible nutrients.

It must be evident, in the light of recent experience with the cactus, that we do not at present realize the enormous possibilities that lie in this despised fodder plant. When we awake to the worth of the cactus, especially the spineless type, we shall no doubt give it more attention as to soil and moisture, because it deserves good soil and occasional irrigations; this is all it requires to become the salvation of the drought-stricken areas.

The spineless cactus has sometimes been criticized because of its slow growth, but we should not regard three seasons as being too long

PLATE IV.—Two typical Fusicaulis Trees, about five years old.

for this purpose, in view of the big yield that may be expected later. At any rate, we have no hesitation in saying, after making observation of the two growing side by side with the spineless on the same soil, that the better varieties of spineless cactus are much faster growers than the wild "kaalblad," and very much quicker than the wild spiny variety. The objection is sometimes raised that spineless sorts are not so resistant to frost as are the wild varieties. This is a fallacy, for we have rapid-growing spineless cactus that will withstand as much cold as the wild kinds. The reason for this criticism we feel is not far to seek. In most cases observations in connexion with the wild types have been made on mature plants. Any leaves from such plants which fall on the ground and start to grow are afforded shelter by the older ones. Another point is, that the mature leaves from the old plants frequently fall during the winter. We have noticed this, particularly during the day, after

a severe freeze, when a large number of leaves can be heard snapping off. This means that these leaves are able to start growth early in the spring, whereas the spineless leaf is often planted out late in the season in an exposed spot, and is blamed for not being frost-resistant. We shall consider this point farther on.

In connexion with the value of aloe as a fodder plant, experiments similar to those with prickly pear have been carried out at Grootfontein. The attempt proved a failure and apparently because too much of the worthless part of the leaf was fed, so that the animals would not consume much. The largest consumption per head was only 6 lb. per day. As the animals had got into a very low condition after six weeks, the experiment was discontinued. Experiments with cattle have shown that aloe fed alone and in large quantities frequently causes a sort of paralysis. This was particularly marked

PLATE V.—A patch of "Kaalblad." This variety has very few spines and can therefore be fed to stock without removal of the spines.

in animals with calves. More recent experiments here indicate that, when aloe is supplemented by lucerne, this paralysis does not occur. Animals fed on aloe alone have consumed 150 lb. of chopped-up leaves per head per day, but in spite of this large quantity, animals with calves lost weight rapidly. We are convinced, however, that aloe fed in addition to, say, about 10 lb. of lucerne daily, is most valuable, and with such a ration animals should put on weight and improve in vigour and appearance.

It is in the Graaff-Reinet District that the biggest development in the feeding of the aloe has taken place, and amongst its most enthusiastic users are the brothers Murray. Chopped aloe leaves in quantities of about 40 lb. daily form a regular part of their cattle ration. These gentlemen have demonstrated that when aloe replaces maize silage or mangels, there is no falling off in the flow of milk, and so the aloe leaf has come to be regarded as a most desirable succulent and a feed which is liked by most farm animals.

Many farmers have had unsatisfactory results with the aloe, owing to lameness developing in the animals fed on an exclusive diet of it, but this condition, in the light of recent experience, can readily be prevented by the use of some additional feed, such as lucerne-hay. Even pickings from poor veld would appear to overcome this difficulty. Mr. Sydney Rubidge, of Wellwood, made the following statement: "In my opinion the agave (aloe) is not only the king of plants (of kinds requiring little care), but, together with prickly pear, is the only plant the Karroo stock-farmer need worry about in non-irrigable areas. . . . Without the American agave on the farm, I would feel most insecure and would certainly not attempt farming with expensive breeding animals." It must thus be evident that in the aloe and prickly pear we have a most valuable means of combating droughts. Moreover, in times of plenty there is no reason why the aloe and prickly pear should not find a regular place in the ration in place of part of the more expensive root or silage

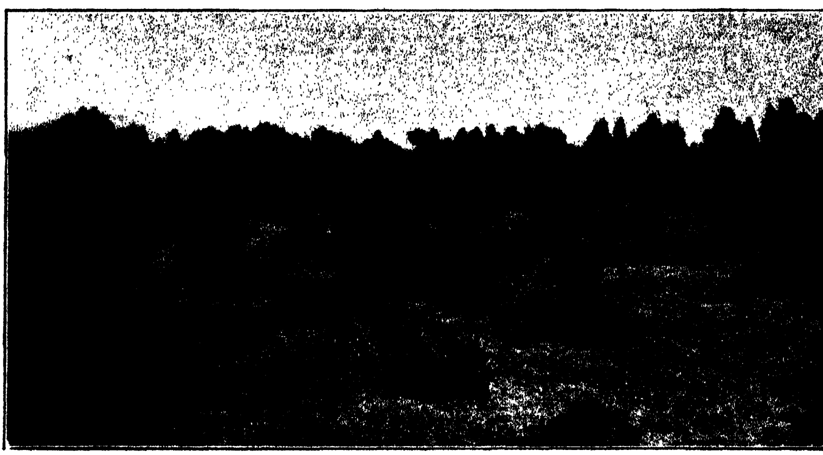


PLATE VI.—Old Man Saltbush Plantation, showing how trees are kept down by grazing. (Compare Plate VII.)

crops, especially because of the high yield, wide range of adaptation, easy propagation, and the efficiency with which they use rainfall.

Although we have no data with regard to the yield and digestibility of aloe, it can be accepted that the mature leaf suitable for feeding will weigh about 10 lb. A mature plant ought to give about twelve such leaves per year; that is, if planted 15 feet by 3 feet (about 1,000 per acre), a yield of at least 60 tons per acre per year can be expected. But the aloe is a slow grower and takes about six years to mature. For a further period of about six years, leaves can be harvested, at the end of which period it flowers and dies. The yield is apparently not as high as that for prickly pear, but according to chemical anaylses, aloe contains about twice as much dry matter as prickly pear, and if digestible to the same extent (no data available) it ought to give for the same quantity twice the amount of digestible nutrients as prickly pear, and we can therefore expect that the yield of digestible nutrients will, under these conditions, not be very much lower than that for prickly pear. But the aloe, like the prickly pear, is low in protein, and for that reason the

feeding of something high in protein in conjunction with aloe is essential.

SALTBUSH.

The production per acre per annum of green, succulent material, in the case of a saltbush plantation, is not known, but with 2,500 plants per acre it ought to be several tons. The material, in comparison with silage, mangels, prickly pear, and aloe, is rich in protein, but the yield per acre is small and in addition it shows a digestibility of only 40 per cent. (prickly pear, 61.5 per cent.), so that the yield of digestible nutrients will not compare with that of prickly pear and aloe. But even so, saltbush is high in protein and can therefore be of use in supplementing to some extent the other two, which are both low in protein. It need not be despised.

(8) It is fortunate that the drought-resistant fodders are not particular about type of soil and climate. The spineless cactus will

PLATE VII.—Old Man Saltbush Plantation, ungrazed for a season, showing vigorous growth. (Compare Plate VI.)

grow on practically any soil, but naturally gives its biggest yields on productive soils. It has been observed growing under the poor, sandy conditions of the south-east Cape and on all the soils characteristic of the Karroo. This applies also to the aloe and saltbush.

(9) There are no fodder plants that can be propagated so readily as the aloe and the cactus, but the saltbush requires more care, although much less than that needed for ordinary trees, and once the bush is established, it will grow with practically no attention.

(10) In choosing the land to be established to drought-resistant fodders, it is essential to pay attention to the following points:—

(a) The site must be sufficiently central so that animals will not have to travel far during times of drought to the spot where the cactus, etc., will be fed to them.

(*b*) Since we advocate the more general use of the cactus and aloe as a succulent in the rations of farm animals to supplement, and often to replace, silage and roots, one of the plantations should be in the vicinity of the homestead.

(*c*) As drought-resistant fodders respond to applications of water occasionally, it would be desirable, where possible, so to choose the site that the plantation may be irrigated at intervals by flood, spring, or borehole water.

(*d*) On account of the value of these plants, and because good soil will increase the yield and is usually plentiful in the Karroo particularly, the plantation might beneficially be established on productive soil.

(*e*) Saltbushes are exceedingly resistant to "brak" soils, and many bare, unsightly patches on the farm, which at present are valueless, could with advantage be established to saltbush, thereby making such spots both useful and attractive.

(11) For these reasons we would suggest that a morgen or two of the lands under irrigation be laid down to cactus near the homestead. Such a plantation should be utilized for providing part of the ration of dairy cows, stud animals, etc. Other plantations would be most useful if located centrally in one, or preferably more, of the camps. The best spot would be near a fountain or borehole, in a part on to which flood-water may be diverted.

Farmers are beginning to appreciate the value of a pure supply of water for farm animals, and many, after erecting windmills, have gone to the expense of building small reservoirs of concrete, which discharge into troughs, to supply clean water for stock. If the plantation of cactus and aloe could be near such a windmill, then it would be convenient, and not at all costly, occasionally to utilize the windmills for irrigating such plantations, which, on account of the high yield of fodder, need not be large.

(12) A morgen of mature (over four-year-old) spineless cactus should each season provide 8 to 10 lb. of leaves to 500 sheep for seventy to ninety days, and it is hardly likely that one would feed so large a number of animals in one camp for so long a period of time. This indicates, however, that a morgen of cactus would be ample in each camp. But it is not suggested that a farmer should at the outset embark on so extensive a scheme as laying down a morgen of spineless cactus in each camp the first year. It could be done gradually, and experience with the first plantation might lead to the selection of better sites for those planted later. Leaves for the other plantations could always be obtained from the one first established.

These remarks apply equally well to the aloe and saltbush. With regard to the latter, additional patches could be planted on the "brak" parts previously referred to. One might imagine that these plantations would entail an immense amount of work, but this is not so, as a simple preparation of the land almost always gives satisfactory results.

(13) We have been quite successful in establishing aloes and spineless cactus by giving the land the following simple preparation: The selected piece of veld has, at suitable intervals, furrows drawn across the slope of the land. Where the land is stony we use a

pavement plough and follow up and down in the same furrow with an ordinary plough. This opens up a fairly well-defined furrow in which the leaves or young aloes may be placed. The object in making the furrow fairly deep is to catch and retain any flood-water that may flow down the slope.

It is not assumed that this is the best method. To get the best response, it would be preferable to plough over all the land to remove grass, bushes, etc., which would otherwise come into competition with the cactus. Experience has shown that when the cactus is planted in well-prepared soil its growth is more rapid. Some who have devoted much of their time to the growth of spineless cactus, maintain that good soil and good treatment result in a decrease in the few spines that are present on these varieties. The preparation of the land should be early enough to permit of the cactus leaves being planted out so as to get best results.

(14) There are many complaints from farmers in connexion with the injury by frosts to spineless cactus particularly. We do not doubt that there are parts where the winters are so severe that the cactus will be established only with difficulty. At any rate, we are able to propagate all varieties at Grootfontein; sometimes the thermometer registers twenty degrees of frost. A great deal of trouble is due to the leaves being planted too late. It has been mentioned that during the winter the ordinary wild pear loses a number of leaves, which become established in the early spring, more or less under the protection of the old plants. We should imitate nature a bit with the spineless sorts. Observations here show that young unprotected plants of the "kaalblad" are quite as sensitive to frost (even more in some cases) as the spineless sort.

To be successful, therefore, plant early, in about August. In warm parts, September or October will do. We do not advocate planting later than this, for as summer comes on, the mature leaves of the cactus start to produce fruit or fresh leaves, which have to be removed if such leaves are planted. This means that some of the food material in the leaves must be lost, and there will be less in the leaf on which to start new growth. This is somewhat analogous to the use of potatoes for seed that have produced long spindly sprouts which have to be removed before planting. Leaves that are planted late will produce shoots that do not have time to mature before winter, with the result that all of the new growth is destroyed by frost. Young leaves are quite tender to frost, but mature leaves are resistant. The aloe can be planted to advantage at the same time as the cactus. In the case of saltbush, the seed is sown in the spring, either in August or September, and later transplanting is carried out when conditions are favourable.

ESTABLISHING THE CROP.

(15) *The Spineless Cactus.*—After the furrows have been drawn at suitable intervals—preferably about 15 feet apart, so as to allow a wagon to pass up and down the rows—the leaves of the cactus must be placed in the rows every three feet or so. This will mean about 1,000 leaves per acre. The leaves may be loaded on a wagon and thrown off into the furrows on each side. This ensures the planting being done expeditiously. In placing the leaves, all that has to be done is to lay the leaf flat on the bottom of the furrow and then to place a spadeful of earth on top. In this method there is no need to allow the leaves to wilt before planting. Where the leaves are

planted upright, wilting would appear to be necessary in order to allow the cut surface to dry before planting. If this is not done, the leaf is likely to rot. The first method is to be preferred, because it takes less time, a better root system develops, and no rotting takes place. Where the winters are very severe, it might be well to plant the leaves in rows alongside trees, which will afford some protection, and leaves should not be planted later than August. Rapid early growth should be encouraged by watering, if possible.

Aloe.—There is no great difference in the procedure necessary to establish the aloe from that already described for the cactus. Two-year-old suckers from an aloe plantation are taken on a wagon and distributed as in the case of the cactus. The espacement of the rows may be similar to that recommended for cactus. The aloes are

PLATE VIII.—Old Man Saltbush Seedlings in tins ready for planting out into field. Creeping Saltbush in the foreground.

held upright in the bottom of the furrow by one man while another throws earth around the roots.

Saltbush.—To be successful with the old-man saltbush, the seed must be sown in well-prepared seed-beds in a shady spot. The seed is planted fairly thinly in order to obviate the necessity of planting out the seedlings into other beds to give them more space. This planting should be done in August. After the seedlings are about six months old they should be planted out into the permanent site, which can be prepared in a manner exactly similar to that for the cactus, excepting that the furrows should be at intervals of six feet, while the plants are three feet apart in the rows. Some 2,500 plants will be needed for an acre. Sometimes old-man saltbush is established from cuttings taken in August. These strike readily, but are not so

good as the seedling, which has a tap-root and seems more drought-resistant. The creeping variety (*Atriplex semibaccata*) can readily be established by sowing the seed directly in the land, sowing being most successful in the spring; 10 lb. of seed per acre are ample.

(16) The aloe and cactus need no special care after planting, but it is essential that the saltbush plants should receive one or two waterings, provided no rain falls. But as the bushes are usually transplanted in March it is frequently possible to take advantage of rain, and no watering will be needed. It might again be emphasized that rapid growth is promoted by watering these plants after planting, and this is especially advantageous in cold parts in order to have the new leaves of cactus well matured before winter.

Again, as stock are exceedingly fond of all these plants, it is essential that the lands or spots on which they are established be fenced off. It is admitted that this is an item of expense, but it should not cost a great deal to put a sheep and cattle proof fence round, say, a morgen of land. It might be noted here that if these plantations of cactus were combined with a shelter-belt of trees, they would be doubly valuable in providing not only feed during droughts, but also shelter from cold and excessive heat, and thereby reduce the need of food for maintenance.

HARVESTING.

(17) *Cactus.*—The spineless variety may be either grazed or harvested. In the latter case, the leaves may be cut up with a chaff or mangold cutter or fed whole. Grazing in young plantations is not to be recommended, but might conveniently be used in older ones. It is probable that larger quantities would be obtained per acre where the leaves are harvested and fed. Prickly sorts have been successfully fed merely by chaffing or pulping the leaves, but some farmers prefer the method of singeing the thorns either in a fire of brushwood or else by the use of a blow-lamp. The latter is used extensively in America and would be useful where the plantations of thorny cactus are thick. All that would be necessary is to burn off the thorns on the outer fringe of the plantation, allow animals to graze off these, and then repeat the process.

Aloes.—It has been found that the most palatable part of the mature aloe-leaf is the thick fleshy end attached to the stem. In harvesting aloe leaves, therefore, it is essential to cut off the leaf close up against the plant so as to include this fleshy portion. The fibrous tip and edges of the leaf are then cut off with a sharp knife, after which the rest of the leaf is cut into five or six longitudinal strips and then crosswise, so as to make small pieces about an inch wide and somewhat longer. A convenient instrument for cutting up these leaves is an ordinary meat-chopper, or even a sickle. A sugar-cane knife would also be convenient. It is estimated that where the aloe plantation is handy, one boy can harvest and cut up in a day sufficient leaves for from 300 to 500 sheep. Where much larger quantities are required, a hand-power machine such as a root-cutter may be used.

Saltbush.—The animals are always allowed to do their own harvesting in the saltbush plantation, but the plants should not, of course, be fed off during the first season or two.

VARIETIES.

(18) *Spineless Cactus.*—A study has been made at Grootfontein in connexion with the characteristics of different varieties of spineless cactus. These observations have included the following:—

Fruit Production.—All varieties, with the exception of Protectorate, produce some fruit, but a shy bearer of fruit has been

PLATE IX.—Left: The correct way of harvesting Aloe Leaves; the leaves are cut right at the base, so that the thick fleshy portion of the leaf, of greatest value in feeding, is removed as well. Right: The incorrect way; the thick fleshy portion of the leaf is left on the tree.

found in Fusicaulis. Now, the fruit habit is important, because the plants from the seeds of spineless sorts are often spiny, so that it is desirable to grow a non-fruiter. With proper precautions, however, one need not worry much about the fruit, for it has been proved here that if one removes or feeds all the one-year-old leaves from the plant, very little fruit will form in the next season, as the plant seems to spend all its energy in producing a fresh crop of leaves.

Resistance to Frost.—Out of a dozen or more varieties it has been found that there are about four which are very frost-hardy. These are, in order of merit: Fusicaulis, Guyaquil, Hardybred, Protectorate, and a variety of Anacantha. In many cases non-resistance to frost is due to very slow growth in the early part of the year, so that the new leaves are still young and tender when winter

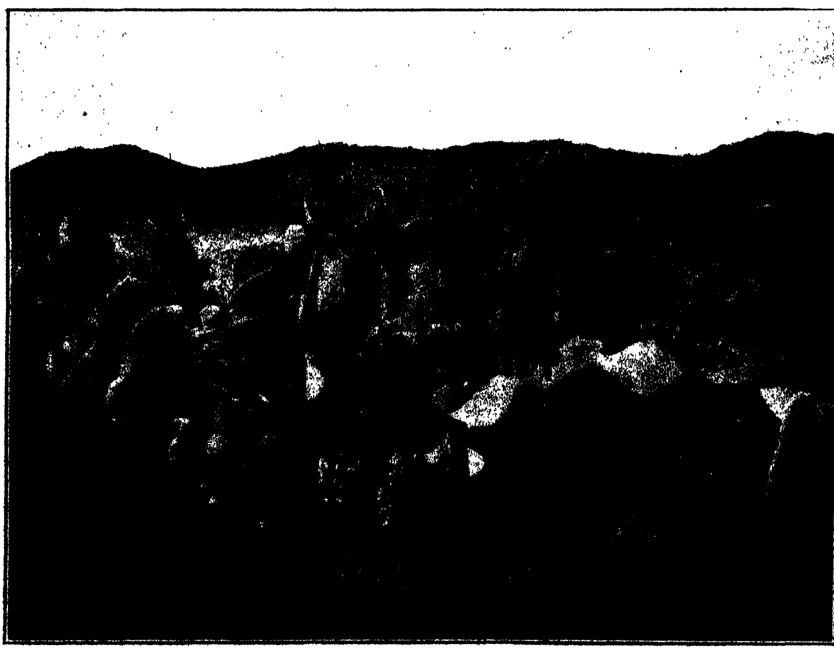


PLATE X.—Mature Leaves not removed in Spring. Note large number of Fruit.

sets in, or else it is due to very rapid growth, with the result that many young leaves have just been formed by the time when "freezes" are experienced. The result is that the plants are condemned as non-resistant in spite of the fact that all of the mature leaves remain uninjured.

Rapid Growth.—With the outstanding exception of Protectorate, which is a very slow grower, particularly in the first season, the majority of varieties grow fairly rapidly, and there is not much to choose between them.

Resistance to Drought.—All that may be said now, is that we do not have sufficient evidence to claim any superiority of one variety over another. Taking all things into consideration, we feel that the most desirable of all varieties, so far as Karroo conditions go, is the Fusicaulis.

Saltbush.—The only two sorts of saltbush that need mention here, are the Old-Man (*Atriplex nummularia*) and the Creeping (*Atriplex semibaccata*). The first is an upright grower, which may attain the height of ten or more feet, depending on conditions, while the other is a creeping sort. Both are characterized by their extreme drought-hardiness and resistance to frost. They remain succulent, therefore, in the winter and during drought. The response made by these bushes to an occasional watering is very marked. One of the difficulties in connexion with the creeping sort is its rapid spread from seed carried in flood-water or blown by wind. This results, sometimes, in the saltbush becoming established in the lucerne lands, which, of course, is undesirable. On the other hand, the ease with

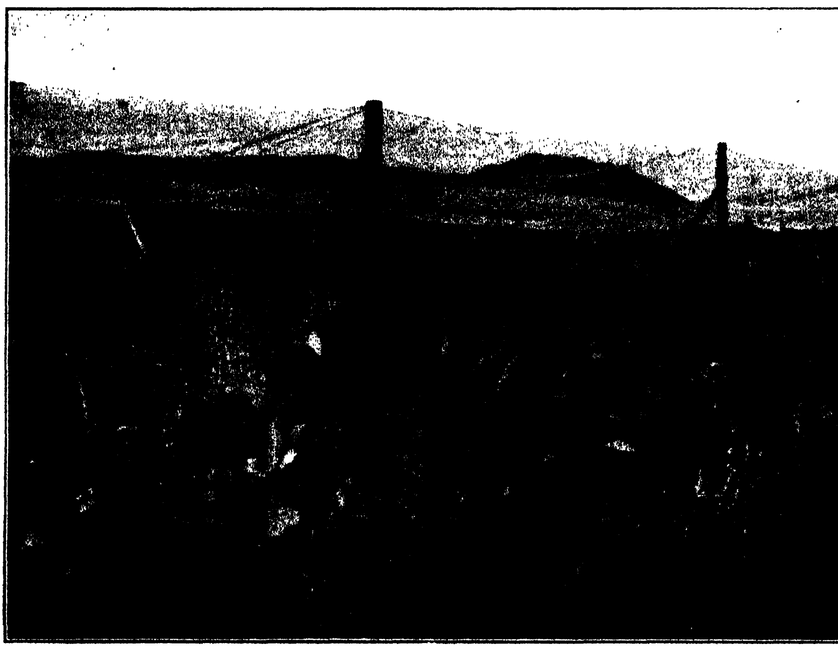


PLATE XI.—Mature Leaves removed. Note the absence of Fruit.

which creeping saltbush may be established from seed is a point in its favour.

(19) In conclusion, let it be said that the value of these drought-resistant succulent fodders is now only appreciated by a few farmers, but the day will arrive when they will come into their own. Then we shall not be looking to artificial rain-making for the salvation of the drought-stricken areas, but will find it in the humble and often despised cactus, aloe, and saltbush.

Let us all establish plantations of drought-hardy plants in sufficient quantities on every farm to make us independent of other forms of succulence, and sometimes even of water itself, and so hasten the day when we can laugh at droughts.

INQUIRIES AND REPLIES.

SELECTED LETTERS FROM FARMERS.

[Hereunder are a number of recent letters replied to by the various Divisions and Schools of Agriculture concerned. They are selected for publication as being of interest to farmers generally in the localities affected. In each case the area only from which the inquiry emanates is given; as the replies must necessarily be curtailed, they will indicate, when required, literature from which further information may be had. All departmental bulletins quoted are obtainable on application to the Editor.]

Planting of Kikuyu Grass.

Colesberg.—Please advise me how to establish Kikuyu.

Grootfontein School of Agriculture replies: The most satisfactory time to establish Kikuyu is in the spring or early summer. If planted in the autumn in the Karroo the plants are usually completely destroyed by frost. It can be planted on dry lands, but the results are usually very unsatisfactory; nor do we recommend the use of Kikuyu in the Karroo on irrigated lands.

The land must be prepared thoroughly; furrows are then ploughed at intervals of 6 feet, and in these the roots are placed every 3 feet. To cover the plants ploughing can be resorted to, by which means the soil is turned back into the furrow, or the soil can be shovelled on to the root by hand. A small portion of the root must, however, be above the level of the soil. Care should be taken not to allow the roots to become dry before planting.

Harvesting Mealies.

Thomas River.—What is the best way to harvest mealies so that the stalks will have their greatest nutritive value?

Grootfontein School of Agriculture replies: The crop is harvested, i.e. the cobs left on the stalks and the stalks cut just above the ground when the maize kernels are in the hard glaze stage, that is, when the kernels are so hard that one is just able to make a small indentation with the thumb-nail on it. It can be cut with a kaffir hoe spade, or else with a sledge to which is fastened on the one side a sharp blade. The plants are then stacked, as follows:—

(1) Make bundles of the mealie stalks after they have become thoroughly wilted, the bundles being of a convenient size to handle, and containing about 25 stalks. Lay these bundles in the form of an X until the X is about 3 feet high; then place other bundles in the angles of the X and so make a conical pile. Or (2) leave a few plants standing on each side of the row, draw the tops together, and fasten them. Then place bundles against these standing plants to form a conical pile. The stalks can be left on the lands for a month or two. When dried out, the cobs are removed from the stalks and thrashed, while the stalks are preserved in stacks for further use.

Beans under Irrigation.

Mortimer, Cape Province.—Can field beans be grown under irrigation; and which varieties are the best?

Grootfontein School of Agriculture replies: We have carried out experiments in connexion with the growing of field beans under irrigation in the Karroo and find that this crop can be satisfactorily grown provided a fertile soil is utilized, or else good manuring is given. The amount of success, however, is dependent to a considerable extent upon the variety grown. From observations it would appear that one of the most prolific varieties is Small Khaki. Another good variety is Canadian Wonder; while Lazy Wife and Canterbury are also two very useful varieties. We have tried two varieties of sugar beans and find that these are not so productive as the ones mentioned above, although they sell at a somewhat higher price.

Fodder Plants for Sheep.

Grahamstown.—Will prickly pear and creeping salt bush maintain sheep?

Grootfontein School of Agriculture replies: Prickly pear and salt bush can be looked upon only as a stand-by and as plants producing succulence and some feed under conditions not very suited to plant growth. They will naturally have their greatest value during periods of drought or during the natural dry season of the year. The two will serve to tide sheep over long periods of drought, say, two to three months or even longer, but they are not sufficient to maintain animals, both being very succulent, so that the animal cannot get sufficient "dry material" to provide its wants; prickly pear, in addition, is deficient in protein. The feeding of a feed like lucerne-hay in conjunction with prickly pear ought to give satisfactory results.

Sugar Beet in South Africa.

Mortimer.—Does sugar beet do well in this country, and what will it be like under irrigation? Also, have factories been established for the manufacture of sugar?

Grootfontein School of Agriculture replies: Sugar beet is utilized mainly for the manufacture of sugar, although in this country no attempt has been made to utilize the crop for this purpose. As a factory costs several hundred thousand pounds and only works for about three months a year, it must be clear that before one can be established a considerable area of sugar beet must be grown in order to guarantee a sufficiently large quantity of beet. It is estimated that 2,000 acres of sugar beet must be grown annually before a factory can be established, and as the crop cannot be grown on the same lands every year, some 6,000 or 8,000 acres are required in order that a proper rotation with sugar beet every three or four years can be carried on. This land must be in close proximity to the

factory. That sugar beet can be grown satisfactorily under irrigation is well known, and recent experiments in the Gamtoos Valley seem to show that this crop grows fairly well under irrigation in the coastal area, and that the sugar-content is sufficiently high for factory purposes. This crop requires a tremendous amount of hand labour in connexion with harrowing, thinning, harvesting, and topping.

Controlling Marrow-fly and Other Insects.

Mossel Bay.—Will you please give me information *re* control of marrow-fly and of insects which damage the leaves of cabbages?

Elsenburg School of Agriculture replies: For the marrow-fly trouble I would advise you to apply the fruit-fly remedy, which is the following:—

Arsenate of lead ...	3 oz. paste or 1½ oz. powder.
Treacle	2 lb. (or sugar, 2½ lb.).
Water	4 gallons.

Mix well, and with a fine-spraying garden-syringe squirt the spray up into the air, above the plants, so that the leaves are sprinkled with very fine drops of poison, which, being sweet, attracts the fly. This method must be applied before the flies have had the opportunity to lay their eggs.

The spray recommended for the insects which damage the leaves of cabbages, etc., is the following:—

Arsenate of lead ...	1 lb. powder or 2 lb. paste.
Capex spreader ...	¼ lb.
Water	40 gallons.

Again mix very well and keep stirring while spraying.

Points on Fusicladium Control.

Constantia.—Please give me some points on the control of fusicladium.

Elsenburg School of Agriculture replies:—

(1) Use of lime-sulphur (e.g. Capex) at the rate of 1 in 10 as a late winter spray. This may be regarded as a general utility spray. Provided it is put on before the buds open, it is advisable to apply it as late as possible in the winter.

(2) Summer sprays—at time of blossoming and setting of fruit—as deemed necessary according to the intensity of the infection; the spray, bordeaux mixture of the 4-4-50 or 4-4-75 strength, is preferable to diluted lime-sulphur, as the latter is apt to cause burning.

Bordeaux powder is now a commercial product of great value to small growers, and may be used in preference to home-made bordeaux mixture.

The spray may, for sake of economy, be mixed in with the lead arsenate, used for codling-moth control and applied at the same time.

Irrigation Plant.

Ingogo, Natal.—(1) How many gallons of water will be required to adequately irrigate 20 acres of ground weekly? (2) What horse-power oil-engines and what size centrifugal pump will be required to force this quantity of water up 30 feet daily for eight hours and for six days in the week, taking into consideration the suction distance? (3) What size pump and horse-power to irrigate 40 acres? (4) What machine has given the best results for this work up to the present?

Cedara School of Agriculture replies: (1) This is governed by the nature of the soil, the climatic conditions, and plants to be irrigated. The nature of the soil in the first instance might be capable of absorbing more water than is really required to grow the crop. It is therefore possible to give only general figures, which will act as a guide.

3,630 cubic feet of water will cover 1 acre 1 inch deep.
7,260 cubic feet of water will cover 1 acre 2 inches deep.
8,075 cubic feet of water will cover 1 acre 2½ inches deep.
378.125 gallons per minute will cover 1 acre 1 inch deep in one hour.
756.25 gallons per minute will cover 1 acre 2 inches deep in one hour.
945.3125 gallons per minute will cover 1 acre 2½ inches deep in one hour.

(2) Water is not constantly flowing on lands. It is a good practice to apply water, say, once in ten days and cultivate more frequently, so that the question of pumping water for eight hours per day for six days per week to irrigate 20 acres is an unbalanced proposition. See answer to (3) below and make deductions.

(3) The duty of water should be as high as possible, that is to say, it should be applied to lands most economically, and not to apply 2½ inches where 2 inches will do, and more particularly when you are using power to supply the water. It is one thing to irrigate but another thing to apply water to lands commercially. The 40-acre problem presents a more evenly balanced unit, being divided into 8-acre plots or five lots, irrigated at the rate of 8 acres per day of eight hours, and only for five days per week, thus allowing irrigation to be carried out under the general rule of applying water, say, every ten days, and not, as the question suggests, every day.

The lift from water to centrifugal pump may be taken at 17 feet and the discharge height 30 feet, making a total of 47 feet. But if we take the total at 50 feet, this may allow for inaccuracies in present measurement.

Then, an oil-engine developing 10-brake horse-power at the coast will deliver the equivalent amount of water to cover an acre of ground 1 inch deep when working at an altitude of 3,000 feet. A 20-brake horse-power engine will deliver the equivalent amount of water to cover 1 acre 2 inches. A 25-brake horse-power engine will deliver the equivalent amount of water to cover 1 acre 2½ inches.

It is just possible that such sizes might not actually be held in stock by engineers or agents, therefore the next size larger may need to be used. A 6-inch centrifugal pump will suit.

(4) The oil-engine for such work would cost too much to run. The suction gas-plant, so far, is the most economical outfit for irrigation. A 20-brake horse-power engine working a 6-inch centrifugal pump throwing water at the rate of 750 gallons per minute would cost approximately £650.

Mealie Hok.

East Griqualand.—I wish to build a mealie hok to hold up to the equivalent of 200 bags of shelled mealies, i.e. about 400 bags of mealies on the cob. If the height is not to be more than 6 feet, what area should I give it? I am building it of heavy-gauge wire-netting on poles, the floor consisting of loose stones piled up to about 6 inches from the ground. Will this be satisfactory? The stones will be placed on strips of wire-netting to keep rats out.

Cedara School of Agriculture replies: The following table will assist you to choose that which may best suit your requirements:—

Length.	Breadth.	Height.	Capacity.
45 feet	6 feet	6 feet	Sufficient to hold 200 bags of shelled mealies.
33 feet 9 inches ...	8 "	6 "	
27 feet	6 "	10 "	
20 feet 3 inches ...	8 "	10 "	

With regard to the floor, the type suggested is quite suitable, provided a dry position is selected. Many farmers grout in the joints of the stones with cement and sand.

Storing Mealies.

East Griqualand.—I wish to store my mealies after they are thrashed to save cost of bags, and until the empty bags are returned from elevators for filling for the next loads to town. (*a*) What sized building should I have to hold 600, 800, 1,000 bags of mealies; mealies to slope up from the wooden partition, which, by the way, is 4 feet high? (*b*) Is a wooden flooring better than stone?

Cedara School of Agriculture replies: (*a*) The actual floor space under your plan for 600 bags equals 18 ft. by 16 ft.; for 800 bags, 18 ft. by 21 ft.; and for 1,000 bags, 18 ft. by 26 ft. The measurement 18 feet represents the distance to which the mealies will slope—that will be to a height of 10 feet 6 inches. The mealies to be stored will require to be properly seasoned and not contain more than 12 per cent. moisture. They would require to be turned over every thirty days so as to prevent weevils and moisture affecting the grain. The wall of such a building will require to be well built and strong. (*b*) Yes, but a stone floor built high, covered over with two coats of coal-tar sprinkled over with fine sand, then a 4-inch layer of concrete, would not require repairing, and at the same time would prevent rats from operating from underneath.

Planting Spineless Cactus.

Edenburg.—How and when should spineless cactus be planted? Is it necessary to plough the land, as I have been informed that better results are obtained from planting on unploughed ground?

Glen School of Agriculture replies: The land should certainly be well ploughed and harrowed preparatory to planting cactus. That better results are obtained from clean and thorough preparation of the land has been clearly demonstrated by an experiment made at this Institution last season. Leaves of the same variety, from the same plants, were planted in October both on unploughed land and on newly ploughed land adjoining it. In spite of the good season, the former produced very little growth—only two poor leaves per plant—whereas plants on the ploughed land produced an average of seven or eight leaves each.

The earlier in the spring that cactus is planted the more chance the new leaves have of withstanding the frost the following winter. August and September are the best months for planting, but good results have also been obtained here by planting as late as December.

The most satisfactory method of planting is to place the leaves flat on the ground, with a small sod or stone on top of them to keep them in place. In order to facilitate the removal of the leaves from the land for feeding to stock, the plants should be in rows 15 feet apart, and 3 or 4 feet apart in the rows.

Value of Cotton Seed for Dairy Cows.

Dewetsdorp, Orange Free State.—What is the value of cotton seed as a feed for cows?

Glen School of Agriculture replies: Owing to the value of the oil contained in the seed, the entire seed is not used to any extent for feeding purposes nowadays. Cotton seed has almost entirely been replaced by cotton-seed cake or meal, from which most of the oil has been extracted.

The following table gives the comparative values of cotton seed and cotton-seed cake:—

	Average Percentage Composition.					
	Water.	Ash.	Crude Protein.	Fibre.	Nitrogen Free Extract.	Fat.
Cotton Seed ...	9·4	4·6	19·5	22·6	24·9	19·0
Cotton-seed Cake ...	7·5	6·2	44·1	8·1	25·0	9·1

It will be observed that cotton seed is very high in both fat and fibre. Owing to the high fat-content, cotton seed tends to produce digestive trouble. For this reason it should be fed in limited quantities. The seed should, of course, be crushed before feeding.

Cotton-seed cake or meal is a very good nitrogenous concentrate for dairy cows, and it is generally a fairly cheap source of protein, of which it contains a high precentage. It is better to feed the cake or meal instead of the seed itself.

Cooling a Room for Storage.

Klerksdorp.—Is it possible to cool a room by leading cold air to it, through an underground duct, over a distance of 300 yards? The room is for the storage of butter, fruit, etc.

Potchefstroom School of Agriculture replies: It is not possible to cool the room in the way mentioned. The best method would be to pipe the liquid ammonia under pressure from the compressor to the room to be cooled and cool the latter by allowing the ammonia to expand on the spot practically where the cooling is to be effected. The low-pressure expanded ammonia would, of course, be led through cooling coils in the room to be chilled and then returned to the compressor.

Maize for the High Veld.

Question.—What varieties of maize do you recommend for the high veld? Where is seed obtainable?

Potchefstroom School of Agriculture replies: We recommend the following varieties:—White (for early planting in October), Silver King, and Rooi Stronk Hickory. These varieties are not suitable for the very high regions. For later planting, or if only one variety is planted, we recommend Wisconsin White Dent. This mealie is fast coming into its own, and has been successfully grown by competitors in the Boys' Maize-growing Competition. Other good varieties are American White Flint or White Cango. The Yellow varieties we recommend are Natal Eight Row, Yellow Cango, Polins Cornflake, Boesman (or Cincinnati).

We recommend only the early varieties for the high veld so as to escape the early frosts.

Seed is obtainable from leading seedsmen. It is also advertised in the agricultural Press. We are preparing a list of growers and seedsmen who have seed for sale, and are requesting them to send us good representative ears of their breeds and also samples of their seed. We hope soon to have the best sources for all varieties listed, together with prices.

NOTES FROM THE "GAZETTE.'

Attention is drawn to the following matters of interest which appeared in the *Union Government Gazette*:—

(Abbreviations: "Proc."-Proclamation. "G.N."-Government Notice.)

Gazette. No.	Date.	*Items.*
1488	10/7/25	*Dipping of Cattle.*—The compulsory dipping of cattle has been ordered as follows:— (*a*) Every seven days in the seven-day dip for certain farms in the Pilgrims Rest District. (G.N. 1171.)
1495	31/7/25	(*b*) Every five days in the five-day dip for portions of Lions River, Paulpietersburg, Lower Umfolozi, and Umvoti Districts. (G.N. 1303.)
1495	31/7/25	*Dipping and Hand-dressing of Cattle.*—The compulsory dipping and hand-dressing of cattle in Reserve No. 21, Eshowe District has been ordered, in addition to the five-day dipping already in force. (G.N. No. 1300.)
1497	7/8/25	*Dipping of Sheep and Goats.*—The compulsory dipping of sheep and goats has been ordered for the Districts of Namaqualand, Gordonia, Fraserburg, Williston, Sutherland, Carnarvon, Van Rhynsdorp, Calvinia, and Kenhardt. (G.N. No. 1338.) *Dipping of Equines.*—The compulsory dipping of all horses, mules, and donkeys has been ordered as follows: Every seven days in the seven-day dip (*a*) on all Crown locations in Tamara Area, Kingwilliamstown District, Cape; (*b*) in the Sub-districts of Keiskamahoek and Middledrift, Cape. (G.N. No. 1340.)
1495	31/7/25	*Infected Areas.*—Various farms in the District of Eshowe, Lions River, Paulpietersburg, and Lower Umfolozi have been declared infected in consequence of an outbreak of East Coast Fever. (G.N. No. 1301.)
1491	24/7/25	*Protected Areas.*—For purposes of the Scab Regulations, the District of Taungs, Cape, has been declared a protected area. (G.N. No. 1254.) *Export of Citrus and Fine Fruit.*—G.N. No. 397 of 1925 regarding shipments of fruit for export has been amended by G.N. No. 1262.
1488	10/7/25	*Excision of Portion of Sub-Reserve, Port St. Johns Central Forest Reserve.*—A certain piece of land in extent approximately 2 morgen, portion of Sub-reserve of Egoso Forest, of Reserve No. 11, Port St. Johns Central Forest Reserve, situate in the District of St. Johns, has been withdrawn from the demarcated forest area declared as such by Government Notice No. 1712 of 1922. (G.N. No. 1170.)
1497	7/8/25	*Fencing.*—Contributions towards the cost of (*a*) converting dividing fences into vermin-proof fences and (*b*) erecting vermin-proof fences have been declared obligatory in certain areas of Barkly East District. (Proc. No. 182.)

Gazette. No.	Date.	*Items.*
1490	17/7/25	Contributions towards the cost of dividing fences have been declared obligatory in certain areas of Kenhardt District. (Proc. No. 161.)
1495	31/7/25	A levy for the repayment of the advance made for the erection of a dividing fence between the farm Delville and the Sifonondile Location, District of Xalanga, has been imposed and the date fixed by Proclamation No. 177 of 1925.
1490	17/7/25	*Government Chemical Laboratories—Analyses of Minerals.*—Regulations regarding the examination, analysis, and assay of minerals are published in G.N. No. 1187 of 14th July, 1925.
		Registration of Brands.—Brands registered in the Transvaal during the quarter ended 30th June, 1925, are scheduled in G.N. No. 1220.
		Demarcation of Forest.—The Jessievale Railway Sleeper Plantation, Sub-reserve (*b*), Isabelladale, District Ermelo, has been declared a demarcated forest. (G.N. No. 1179.)
1493	27/7/25	*Sale of Live Stock and Agricultural Produce.*—Particulars regarding the sale of live stock and agricultural produce by public auction are scheduled in Act No. 22 of 1925.
1495	31/7/25	*Holdings Available.*—Applications must reach the Secretary for Lands, Pretoria, before the 11th September, 1925, for certain holdings to be disposed of in the Transvaal Districts of Pilgrims Rest, Lydenburg, Middelburg, and Pretoria. (G.N. No. 1314.)

STAFF: APPOINTMENTS, CHANGES, ETC.

30/6/25 *H. A. Melle*, Officer in Charge, Groenkloof Experiment Station, resigned.

1/7/25 *J. H. R. Bisschop*, appointed Research Officer, Onderstepoort (Field Staff).

1/7/25 *L. P. J. Badenhorst*, appointed Sheep and Wool Expert.

6/7/25 *E. van Munen*, appointed Poultry Officer, Potchefstroom.

11/7/25 *M. Berg, B.V.Sc.*, Government Veterinary Officer, Middelburg, Transferred to Piet Retief.

11/7/25 *James Allison*, Dairy Inspector, Capetown, transferred to Bloemfontein.

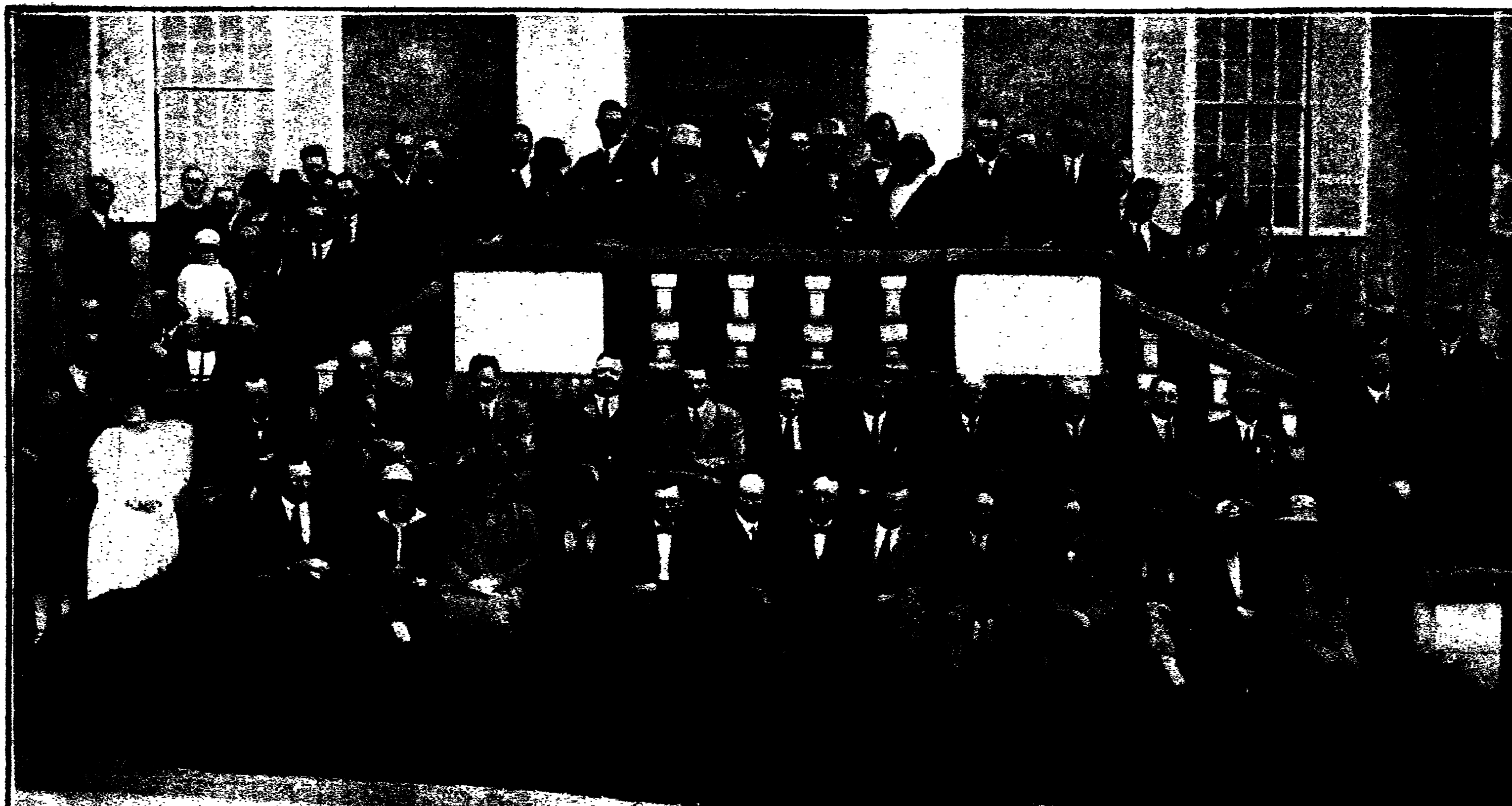
25/7/25 *F. Taylor*, appointed Entomologist, Potchefstroom.

25/7/25 *R. W. Dixon*, Assistant Chief Veterinary Officer, retired on pension.

4/8/25 *J. I. Quin, B.V.Sc.*, Government Veterinary Officer, appointed Veterinary Research Officer, Onderstepoort.

4/8/25 *W. J. B. Green, B.V.Sc.*, Government Veterinary Officer, appointed Veterinary Research Officer, Onderstepoort.

Mr. Arthur Stead, Senior Chemist, Pretoria, and Officer in Charge of the Union Soil Survey, has been granted the degree of M.Sc. in the University of Liverpool.



FIRST ANNUAL PIG-FARMERS' DAY HELD AT THE SCHOOL OF AGRICULTURE, CEDARA, ON THE 7th AUGUST, 1925.

JOURNAL OF THE DEPARTMENT OF AGRICULTURE.

VOL. XI. OCTOBER, 1925. No. 4.

Published monthly in English and Afrikaans by the Department of Agriculture, Union of South Africa.

SUBSCRIPTION: Within the Union and South-West Africa, 5s. (otherwise 6s.) per annum, post free, payable in advance.
Applications, with subscriptions, to be sent to the Government Printer, Pretoria.

NOTES.

Lowering the High Cost of Agricultural Implements.

The prevailing high cost of agricultural implements and the means whereby prices may be lowered is a subject widely discussed among farmers. Prices for these implements continue at almost double the pre-war ones, notwithstanding that the price the farmer now obtains for his own product has receded to the pre-war level—sometimes, indeed, to a lower figure. This condition gives ground for reasonable complaint by the farmer, yet the merchant contends that present prices are not unduly high and that agricultural implements cannot be imported and delivered at a cheaper rate. It is pointed out that the trade in these implements is a difficult one. The economic conditions prevailing have restricted demand, for the farmer makes every effort to prolong the life of his implements in view of the great expense of replacement. From authoritative sources it is learned that for the past four years manufacturers generally have shown a deficit on this line of their business, and that some firms are withdrawing from it, a sure indication that this branch of commerce is not proving remunerative. Apparently the costs mount up in the course of distribution, in the interval following the delivery from the factory and the sale in our country by the retailer. Yet there is keen competition between the sellers of the several makes on the market, which should be a corrective to excessive charges. Factors such as world demand and supply, competition between manufacturers of industrial countries, the several links in the chain of distribution—all have to be considered in determining whether the prices of implements are too high in South Africa.

There is, also, the great diversity of implements on sale—a diversity not justified by local conditions—that leads to increased costs. The multiplicity of makes of implements necessitates dealers, anxious to supply the wants of customers, keeping a large variety of

implements in stock, for some of which the demand is intermittent, so that those implements which sell more readily have to bear their share of the expense of holding in stock those that do not sell easily.

The position in regard to spare parts is even worse, for these, unlike the implements themselves, have no fixed price, and it is from them, it is maintained, that the merchant derives his greatest profit. Here the chief demand is naturally for the parts that wear out most rapidly, but a supply of other parts must also be stocked. And it is the spare part most in demand that must similarly bear the burden of the parts that are in less demand.

It has been suggested that a system of standardization of implements will afford the much-desired relief from the high prices engendered by the large number of makes on the market. Apart from the several trade difficulties in bringing this about, the farmer himself, with his particular taste for a certain make of implement, will prove an obstacle in the way of standardization. But it can be brought about in great measure by organization. Farmers can buy through co-operative bodies, after agreeing upon the type of implement to be adopted by them for use in their particular area. This, moreover, would lead to a lowering of the cost of spare parts, which could then be stocked by the supplier of the particular implements decided upon.

Another means of considerably reducing the high costs would be the manufacture in South Africa of spare parts. At present great waste is occasioned by the discarding of comparatively sound, workable implements on account of essential parts being unprocurable in our country.

Assuming that some system that will induce standardization or, at any rate, a more general use of particular implements only over large areas in the Union as agreed to by farmers in such areas, is the best solution of the difficulty, it is a matter, like so many others that concern the agricultural industry, in which the farmer must organize to secure his purpose. And with it all, due regard must be given to the stimulus of competition among manufacturers which, above all, will lead to that improvement in the class of article put on the market that every farmer should encourage.

The Number of Farmers in the Union.

According to the population Census of 1921, there are in the Union 163,830 European males of fifteen years and upwards who are engaged in agriculture. This is out of a total male European population of 782,035 (of which 320,939 are dependents, children, etc.), and constitutes by far the greatest section of the population.

This means that of every 1,000 European males in the Union, 410 are children and 210 are males of fifteen years of age and over engaged in the primary industry of agriculture. The next on the list is the industrial worker with 119, and then commerce with 102. Transport and communication (railways, etc.) accounts for 40, and mining for 26. The professions are divided into two sections, of which administrative government shows 29 and other professions 21. In every 1,000 there are 13 of independent means.

When the numbers of farmers gainfully occupied (that is actually working for a monetary return) is compared with European males similarly occupied in other directions, it is found that out of

every 1,000 males there are as many as 374 farmers, industry being next with 212, then commerce with 182, transport and communication with 71, and mining with 46; administrative government accounts for 52, and other professions 38. Here we find, also, that the males gainfully occupied in the Cape Province, Transvaal, and Orange Free State are preponderatingly farmers, but that in Natal farmers are only third on the list, industrial workers being first and commercial second.

Fruit Export Control Act, 1925.

In view of serious difficulties which had arisen at the Union ports in the way of regulating shipping space and obtaining uniform treatment for shippers, the Fruit Export Control Act was passed by Parliament in the Session of 1925. This Act established at Capetown, the principal shipping port for fresh fruit, a Board, known as the Fruit Export Control Board, with very wide powers. The Board—

(*a*) controls all fruit shipments from the Union, and can say in what order shipments shall take place;

(*b*) can demand from producers estimates and other particulars of their intended exports for the season;

(*c*) can call upon shipowners to state the amount of space available on any ship appointed to call at a Union port; and

(*d*) can perform any other function regarding the export of fruit which the Government may prescribe by regulation.

The Board may further equalize the rates of freight payable by exporters, the reason being that the Union-Castle Company's boats, which under contract charge a lower rate of freight than do the Australian lines, place at an advantage those shippers who can secure space on the Union-Castle boats over against those who have to ship by an Australian line. Moreover, the Australian lines touch only at Durban and Capetown, and therefore a shipper through any other port (by a Union-Castle Company liner) pays the lower rate in every instance.

The Board may appoint a committee or a person to represent it at any of the ports except Capetown.

No person may export fruit unless under contract or other arrangement with the Fruitgrowers' Co-operative Exchange of S.A., Ltd., and approved and authorized by the Board. Should the Exchange not consent to any contract or arrangement proposed, an appeal may be made to the Board, whose decision is final.

The Land and Agricultural Bank may guarantee the performance by the Exchange of any contract entered into by it with any shipholder for the shipment of fruit.

If in respect of any consignment of fruit for export the producer fails to furnish estimates thereof or comply with any other lawful requirement, the Board may refuse to grant such consignment any priority of shipment which otherwise it might be entitled to.

The fruit export levy bears the expenditure of the Board.

The Act applies to all fruit other than dried or preserved for export overseas, and not to fruit for consumption in Rhodesia and other adjoining territories.

Do not Handicap Sellers by Excessive Reserves.

Timely advice to wool-growers is contained in a report just received from Mr. S. B. Hollings, the well-known Bradford authority, who writes:—

"South African wool-growers will be looking forward with more than ordinary interest to the marketing of their new clip. The outlook cannot be regarded with the same enthusiasm as a year ago; at least there is nothing to indicate anything like the prices which obtained last season. However, that is no reason why every one should not do his best to put before the trade the most attractive clip possible, for while in a time of boom and shortage one may slip over things, it certainly behoves everyone to carefully skirt every fleece and prepare every line of wool for market in the best possible manner. These are not times when carelessness can be adopted, and it is to be hoped that, notwithstanding lower prices in prospect, every one will redouble his efforts in preparing a clip for market worthy of South Africa's name. It is most creditable to be able to say that during the past three years South African wool has risen in the estimation of the trade quite as much as during any previous twenty years, thanks to the inauguration of more up-to-date methods of sheep-farming and the spirit of goodwill which prevails among growers. We regard the development of wool-growers' associations everywhere as a move in the right direction, for, after all, there is wisdom to be obtained in consulting one with the other.

"The decision of the last Middelburg Conference that the best method of selling a clip was by public auction coincides with the view held by the writer for the past twenty-five years. Some may disagree, and while there may be occasions when a private sale can be arranged with satisfaction, we are convinced that every clip should be sold on its merits. That is the best way for the grower to get the last penny of what his clip is worth. The method of a storekeeper paying the same price for all growers' clips is out of date. If a grower has only five to ten bales of wool, by all means let him skirt those fleeces and make a line of combing, pieces, bellies, and locks. Out of those ten bales there should be five or six bales of combings, two bales of pieces and bellies, and a bale of locks.

"Growers will be wisely advised when sending their wool to market not to put excessive reserves on it. Real harm was done by many growers last season in this way. Not a few not only handicapped the seller, but seriously injured their own pockets. The seller who is doing his best to get the utmost farthing should have a free hand, the growers trusting his judgment not to let the wool go unless a market price is being bid. The writer has attended London wool sales for thirty years; he has seen wool sold under all conditions, good, bad, and indifferent, but as a rule when there is good competition and a reasonable market price being bid, it has paid the seller to meet the market and dispose of the wool. We therefore repeat, let no South African grower handicap his selling broker by high reserves, because, after all, it is the seller who is the most able to judge the market value and not the grower. False ideas which the man on the land entertains regarding his produce prevent sound, healthy competition, and if a seller goes into the box prepared to meet the market, providing there is fair competition, then the best thing is done by a sale being effected."

A Critical Season for the Sheep Farmer: Shearing and Prices.

In view of the approaching shearing season and its great importance to the individual and the country generally, it is wished to emphasize certain points which the Department earnestly hopes will scrupulously be given effect to by every wool grower. The position, as set out in Mr. Hollings' report published above, is, briefly, that extra care must be exercised this year on account of market indications in the preparing of the clip, which must be made as attractive as possible.

When prices are booming the buyer may pass small faults in skirting, classing, and packing, but with lower prices and slackening competition the buyer is more critical, and may magnify small faults into large ones and lay stress on the bigger faults. This will mean a very real difference in the price paid when a very narrow margin is being worked on. Therefore it behoves the producer at this critical time of shearing not to undo the care of a long year in the management of his flocks by carelessness in shearing, skirting, classing, and packing his wool. His reputation indeed is at stake. Let him take to heart the following advice:—

(1) Shear carefully, and keep the clip clean. Dirty shearing-boards and catching or drafting yards may mean pence per pound in the price paid for the wool.

(2) Careful skirting and removal of backs heavy with sand or impregnated with kraal manure, will prevent an appreciable fall in the price of the fleece wool, which is depended upon so much to bring in a return to the grower.

(3) Careful classing of the fleeces according to the standards in use by wool growers' associations will please the buyer and facilitate his buying for the various trade requirements. Good prices will follow, and a keen competitor be won for the same grower's clip next year.

(4) Careful packing attracts the eye. The loosely packed, round, lop-sided bale denotes a slovenly farmer. The buyer, expecting that the outward appearance is indicative of the contents, passes on to the more attractive bale. This means one less competitor for the wool or a buyer allowing a big safety margin. But the neat, square, well-filled bale, box pressed or hand-power box pressed, pleases the buyer's eye, who feels that the contents match the outward appearance, and are put up by a careful, honest, and intelligent farmer. More competition for the clip and better prices result.

(5) Guarantee and advertise good work by placing on the bale the name of the grower and of his farm and district. It gives favourable prominence not only to the clip, but to the sheep and land producing it, and so attracts buyers to the district. Advertisement of this kind has done much for some districts where conditions are no better than in other areas where growers fail to take this excellent opportunity of making known to the public the high standard of their carefully grown and prepared clip.

The shearing season is at hand. It rests with the grower to reap the full reward of his year's work. The best price can be obtained only by good shearing methods, correct skirting, etc., proper classing, and attractive packing.

Foundations of Better Farming.

The Principal of the Glen School of Agriculture has forwarded a letter received from a past student, which is typical of the spirit of progress embuing those who have had the opportunity of taking the full course at a School of Agriculture. In the course of his letter the writer remarks:—

Towards the 7th or 8th we expect to commence thrashing mealies, and then to proceed with the cultivation of oats and, when possible, to plough the lands for maize also. My father attaches much faith to winter ploughing. Unfortunately, circumstances do not always permit this. Our further intention is to plant less mealies and then to treat everything with fertilizer. By means of crop rotation we hope to start with green manuring, and for this I intend cultivating cow-peas. Fertilizing, especially superphosphate, has been practised this year with remarkably good results, and is spoken of with the greatest enthusiasm wherever it has been used. . . .

I would again say a few words in appreciation of what the agricultural lectures and the farmers' weeks have meant to us. Often lecturers must have felt despondent at the small attendance; yet the few seeds sown have germinated, and are producing fruit. There is a keen desire amongst all farmers to acquire knowledge, and they all realize that they know little and should know more. The "experts," as they are called, are not viewed in a contemptible light. People who have only farmed because farming happened to be farming are now beginning to realize that things can be done in a far better way. To have roused this desire for knowledge justifies the efforts taken to address an audience comprised sometimes of but two or three people. . . . I have derived the greatest benefit from my stay at Glen.

Bulletins of Interest to Farmers.

Attention is drawn to the list of Departmental bulletins published elsewhere in this issue. Many others are available to the public, and any one wishing to obtain literature on specific agricultural subjects should apply to this office for the Department's full list of bulletins. The list is supplied free of charge. Regular readers of the *Journal* will find, however, that a great many of the listed bulletins are reprints of articles that have appeared in the *Journal*.

DEPARTMENTAL ACTIVITIES.

(NOTE.—The work of the several Divisions and Schools of Agriculture covers a wide range of agricultural industry in the Union, and we give hereunder notes and observations from certain of them treating with matters of special interest coming under their purview month by month. The object of these notes, which are not concerned with general routine work, is to inform the farmer of such matters as are calculated to be of interest and helpful to him.—EDITOR.)

THE DIVISIONS.

ENTOMOLOGY.

Cotton Seeds in Second-hand Imported Bags.—A cotton farmer of Potgietersrust stated in a recent letter that he had found odd cotton seeds in some bags from a bale of second-hand grain bags he had purchased in Johannesburg. On inquiry he had been informed the bags were second-hand when imported, and he suspected they came from India. He asked if there was not danger of a serious cotton pest getting into the country with such importations. Five sound seeds which he said he took from one of the bags were sent with his letter, and the Acting Chief of the Tobacco and Cotton Division pronounced these seeds to be of Indian cotton. It will be readily understood that so long as second-hand bags are imported there will be risk of some of them containing a few cotton seeds. The great majority of bags in a consignment might have been used only for maize or wheat, but some might have been used for cotton seeds in a pink bollworm country. Cotton growers are asked to bear this situation in mind when they propose to buy bags.

Tsetse Fly in Zululand.—In this *Journal* for July, 1923, there was a note upon the use of dummy animals to attract tsetse flies.

The observations on behaviour of tsetse towards dummy animals have been continued by Mr. R. H. Harris at the White Mfolozi River, Zululand. Concerning the latest developments he reports as follows:—

"Experiments on the open beach were continued throughout the month (June, 1925), and it was found that flies could be captured at a bushbuck (stuffed) when standing in the open 200 yards from the bush, while it was also demonstrated that flies could be captured at a dummy donkey when 900 yards out on the open sand beach.* When the bushbuck was covered with white muslin it was apparently invisible to the flies except when placed amongst the bush where flies were known to be present; in the open it was quite unattractive.

"An artificial patch of green bush 30 feet in circumference and 10 feet high was erected on the open beach 500 to 600 yards distant

* The beach here under reference is a sand-spit formed in an elbow-bend of the White Mfolozi River, in the heart of the fly-country.

from the nearest bush, and the dummy donkey was used as a bait animal. It appeared that the conspicuous bush acted as an additional attractant, more flies being taken than when the donkey had been there alone.

"Experiments with a bush-pig in a lying position did not show that this animal was highly attractive when lying down, but, when raised off the ground on short legs, flies came to the legs. Weather conditions have been much against experimental work, in that frost has been present on many nights with cold winds during the day. Mr. Cairns made the interesting observation that flies confined in a wire-gauze cage exposed to a temperature of 32° F. did not appear to suffer from the exposure; the lowest temperature recorded in the bush has been 36° F. It was recorded that the capture of flies in experiments occurred after midday, as might be expected after the cold nights."

Later.—

"Experiments were continued on lines similar to last month. The patch of bushes erected on the sandy beach gradually seemed to become less attractive to flies as the now dried leaves fell. Fresh green bushes were therefore cut and erected in place of the dried ones—after several days of no catches under the old conditions—and it was found that flies were again attracted to the new green bush.

"An experiment was started to test the effect of lengthening the legs of a dummy, and it was found that when a sack dummy was stood on legs 5 feet in length flies came to the legs and belly. At 6 feet all flies came to the legs only. At 8 feet similar results were recorded. At 10 feet there were no captures on two days. The experiment is still in progress.

"My impression is that a limit or zero point will be reached when the fixed focal range of the fly fails to encompass the picture of an animal due to the distortion caused by the very long legs. I have devised a contra experiment, and intend slinging a dummy body on a wire at the height of the long-legged dummy at which it is no longer attractive, and intend attaching short legs at first and gradually to lengthen them. This should give a possible mean, though I imagine it will largely depend on the background in any results which are obtained.

"Experiments with the bush-pig raised from the ground were continued, and showed that the fly has a preference for the object raised from the ground over the recumbent body. Comparisons of this experiment with that of the long-legged dummy give the impression that the fly has a fairly constant level of flight which might well be regulated and limited by the visionary and focal range capacity of the eye of the insect to encompass the size of the object encountered. Thus a long-legged dummy which might have attraction at the limit of the visionary range would perhaps lose its attractiveness on nearer approach through failure of the eye to take in the whole picture, assuming of course that each facet of the eye of the insect takes in a portion of the picture of a particular object. This could not be described as short-sightedness, but rather a limit of capacity on the part of the eye to include the whole picture of an object of certain magnitude except at a definite range, and this range will naturally vary with the conspicuousness of the object."

Cotton Entomologists.—In order that more attention may be given to cotton insect problems, particularly bollworms and jassid, Mr. H. K. Munro has been transferred from East London to Pretoria to relieve Mr. G. C. Haines of routine duties and so enable him to give his full time to the direction of cotton insect investigations. Mr. A. J. Smith will continue studies on the bollworms at Rustenburg. Mr. C. L. Chapman, who was stationed at Barberton, has resigned, but his place will be filled shortly. Two additional entomologists will be engaged for cotton pest studies. By this arrangement the full time of five officers will be directed to these studies.

DIVISION OF VETERINARY EDUCATION AND RESEARCH.

Disease in Cattle and Sheep due to Mouldy Mealies.—A good rainy season usually means good crops and general prosperity for the farmer, but unfortunately there are many dangers lurking in too wet a season. After the excessive rains at the beginning of this year, the worm parasites, especially those of sheep, increased enormously, and the result was the very severe losses which many farmers have experienced, more particularly in their young stock.

The heavy rains were also responsible for a bumper mealie crop, but at the same time promoted the growth of various parasites on the mealies. Of these, the fungus *Diplodia zea* is the most important. Some years ago it was proved by experiments carried out by Mr. Mitchell of this Division that mealies infected with this fungus will produce a fatal disease in cattle; and this year very numerous complaints about this disease have come to our notice.

It is the practice of farmers in all mealie-growing districts to turn their cattle and sheep into the *old mealie lands* as soon as veld grazing becomes scarce. Many farmers also have a habit, when harvesting, of leaving all defective cobs on the stalks or on the ground, and so providing additional feed for the animals. In dry years this may be all right, but after a very wet season, such as we had last summer, a comparatively large percentage of cobs get mouldy and becomes a source of danger to the animals grazing in such lands. Some farmers reported that 25 to 30 per cent. of their mealies were thus infected. It must be noted that the stalks may also harbour the fungus, but this is exceptional; usually the infection is confined to the cobs.

If *cattle* are grazed in such lands, serious losses may be expected. When first noticed ill, the animal may only show a somewhat peculiar gait and perhaps muscular tremors with lachrymation and salivation. Later on the movements become inco-ordinated; the animal may knuckle over at the fetlocks or stumble frequently and fall. After another day or so, the animal may be unable to rise without assistance, and towards the end of the disease it is completely paralysed. Such animals may continue feeding and drinking until shortly before death.

This disease has been known for several years as occurring in cattle, and occasionally reports were received that *sheep* were also affected. However, it was only this year that feeding experiments carried out at Onderstepoort with this class of stock were successful. Mealies infected with *Diplodia zea* were fed to sheep, and symptoms,

practically identical with those previously observed in cattle, were produced. These results justify the conclusion that the numerous losses reported this year amongst sheep which were grazed in old mealie lands must be ascribed to this fungus.

As soon as an animal is noticed ill, it should be removed to a stable or kraal and given some green feed or other easily digestible foodstuffs. Many animals will recover without further treatment. A purgative dose should be given so as to drive out the poisonous material.

In order to minimize losses, the following *preventive measures* should also be carried out. Where the cobs are known to be infected, cattle and sheep should not be allowed to graze in the old mealie lands. To prevent a reinfection of the lands in future years, the old lands should be burnt and, if possible, allowed to lie fallow for one or more seasons. Furthermore, *all* cobs should be collected when harvesting, in which case animals could be allowed to graze in the lands with comparative safety.

DIVISION OF EXTENSION.

Conference of Extension Officers.—A quarterly conference was held in the Union Buildings on the 10th and 11th September. Many important questions affecting the progress of agriculture in the Union were discussed. The Minister of Agriculture complimented the Chief of the Division on the splendid work done by the extension officers, and noted with pleasure the general approbation amongst the farming community of the new system of extension work introduced through the appointment of extension officers to serve definite areas. It is hoped that additional officers will be appointed in the near future to meet more adequately the requests received from different districts.

A definite policy has been adopted with regard to all future extension work by which all problems affecting the farming industry will be attacked. In this respect it is proposed to outline a programme of work for each phase of farming in order that all the forces at the disposal of the Department may be co-ordinated and assembled to develop that particular phase, and to solve the problems which may have a retarding influence on the development of that particular type of farming. The desirability of working through farmers' organizations was emphasized, and extension officers will receive instructions to increase their efforts to persuade farmers to "link up" with existing organizations.

BOTANY.

Umfufu Gras.—Sir Thomas Lyndoch Graham, who has a farm near Naboomspruit, Waterberg District, writes most enthusiastically on the subject of Umfufu, which he has grown on his farm for some years. Umfufu is a very near relative of Napier fodder or Elephant grass: in fact the authorities at Kew have, on seeing only dried herbarium specimens, identified them as the same grass—*Pennisetum purpureum*. They are, however, noticeably different in their growth and general appearance, and the Napier fodder has not been known to flower in the Union, and is not even a very prolific seeder in its native country, Rhodesia, while the Umfufu flowers readily and plentifully.

Sir Thomas writes as follows:—

"I enclose a photo of a wind-break of Umfufu grass on our farm at Naboomspruit. You will note the way the cattle have eaten it near the fence. It makes a really first-rate wind-break for gardens and orchards. This lot is planted in dry sandy soil. Some tried in richer and damper ground did not do so well.

"A few years ago we tried Napier grass, but it did not answer. The cattle disliked it and it died off in the winter. The stand in this photo was still green at the end of July, when I left the farm. Of course some of the leaves were dry, but the plants generally were green and had to be protected from the stock. We have not tried it as hay, nor as pasture seriously, only cutting it when necessary to reduce its

A Windbreak of Umfufu Grass on Sir Thomas Lyndoch Graham's farm Weltevreden, Naboomspruit, taken April, 1925.

height, but, as already stated, horses and cattle eat it very freely, abandoning the natural pasture in the vicinity.

"Evidently, from our experience, (*a*) the grass does not flourish in damp ground; (*b*) it thrives in sandy soil well drained; (*c*) cattle and horses prefer it to Napier; (*d*) it yields a very much heavier crop; (*e*) it is far more easy to propagate; (*f*) it does not die off in winter, though our frosts are heavy; (*g*) in damp soil it dies to the ground level."

The Division will be glad to hear from any other farmer who has grown Umfufu.

THE SCHOOLS OF AGRICULTURE AND EXPERIMENT STATIONS.

ELSENBURG, MULDERS VLEI.

Extraction of Nicotine from Waste Turkish Tobacco.—The Entomologist, Dr. F. W. Petty, and Mr. A. Skibbe, M.Sc., of the Chemistry Section, have been experimenting on home-made tobacco extracts. The results of their preliminary investigations are as follows:—

For the utilization of tobacco waste in the preparation of a suitable spray, it is essential that the final spray solution should contain from .05 to .1 per cent. of nicotine for the effective control of aphids.

It is popularly supposed by farmers that to obtain the nicotine in solution, the tobacco should be boiled for about an hour. Rather extensive experiments were carried out at Elsenburg which prove that it is possible to extract the nicotine as efficiently by means of cold water as by hot or boiling water. The amount of nicotine lost by boiling the tobacco in water for half-an-hour amounted to about 3 per cent. of the total nicotine extracted, which can be considered as negligible.

For the purpose of preparing the tobacco spray it is not advisable to use the stems alone, for their nicotine-content is too low. The most suitable material to use is the waste tobacco leaves.

A spray mixture was prepared by treating 10 lb. of waste tobacco leaves with 10 gallons of water. In one case the water was brought to boiling point and the tobacco was then added to it and boiled for half an hour; the liquid was then poured off, the leaves were squeezed to remove adhering water, and the final solution was made up to 10 gallons. In comparison, the same amounts of tobacco and cold water were used, but were left to stand overnight, i.e. for 12 hours. The solution was then poured off and the leaves pressed, and again the volume was made up to 10 gallons.

In the case of boiling water it was found that the spray contained .076 per cent. nicotine, whereas with the cold water the amount of nicotine was equivalent to .083 per cent. Therefore both mixtures answered the requirements of strength of nicotine for aphis control. It must, however, be borne in mind that it is rather difficult to obtain leaves with the same nicotine-content.

Limited practical tests carried out at Elsenburg in the control of black peach aphis demonstrated that the material extracted by means of cold water was as effective as that extracted by boiling water. In these tests a concentrated tobacco extract containing 7 per cent. nicotine was also used; this extract was diluted a hundred times with water, giving a concentration of approximately .07 per cent. nicotine. The resulting solution was then sprayed on the tree and proved effective in the destruction of the black peach aphis.

Extensive laboratory experiments, including short and long periods, of boiling waste Turkish tobacco leaves in water in comparison with periods of soaking in cold water show that, contrary to reports of other writers, the loss of nicotine by boiling is inappreciable.

The Feeding Practice in the Elsenburg Friesland and Jersey Herds.—The following is a résumé of the feeding practice in operation in the Friesland and Jersey cows at Elsenburg School of Agriculture:—

Concentrates:—(*a*) *Maintenance.*—Firstly, provision is made for each cow to receive according to her maintenance requirement half a pound of concentrates per 100 lb. live weight of animal per day.

(*b*) *Production.*—Secondly, provision is made for each cow to receive according to her milk and butter-fat production one pound concentrates per 5 lb. milk produced in the case of Frieslands and one pound concentrates per 4 lb. milk produced in the case of Jerseys. Concentrates, consisting of crushed oats, wheaten bran, mealie meal, brewer's grain or malt culms, oil-cake (Lobol, when groundnut is not available), in the proportion of 1:1:2:1:1/3.

Roughage (dry).—With both Frieslands and Jerseys, roughage consisting primarily of a mixture of oat-hay and lucerne-hay in equal proportions is fed on the basis of three-quarter pound per 100 lb. live weight of the animal per day.

Succulence.—With both Frieslands and Jerseys, succulence consisting primarily of such green feeds as kale, mangolds, kaffir watermelon, etc., and ensilage such as mealies, oats, and vetches, according to the season of the year, is fed on the basis of two and a half pounds of succulence per 100 lb. live weight of the animal per day.

Pasturage (Artificial and Natural).—During the spring and early summer months, August to November included, really the only time of the year when any value at all can be placed on the artificial pasturage and natural grazing, the feeding of succulent feed is reduced to practically nil, and the concentrated feeds are likewise reduced to approximately one-third of their normal amounts.

Mineral Matter.—In all cases, sterilized bone-meal and common salt (coarse) are added to the concentrated (grain) feed at the rate of one and two pounds respectively per 100 lb. of the feed mixed.

Examples.—The Friesland cow, "Elsenburg Virgilia," whose live weight is approximately 1,300 lb. and daily production 60 lb. milk, testing 3.3 per cent. butter-fat, is fed:—

For Maintenance—Concentrates	... ...	6½ lb.	Total 18½ lb.
For Production— ,,	... ...	12 ,,	
Roughage (dry) ...	...	9–10 lb.	
Succulence	... ...	30–35 ,,	

The Jersey cow, "Elsenburg Gentian," whose live weight is 800 lb. and daily production 40 lb. of milk, testing 5.4 per cent., is fed:—

For Maintenance—Concentrates	... ...	4 lb.	Total 14 lb.
For Production— ,,	... ...	10 ,,	
Roughage ...	... ...	6 ,,	
Succulence	... ...	20–25 lb.	

N.B.—Should any animal clean up her feed fairly quickly, she is given a little extra dry roughage and succulence.

Soil Types in the Robertson-Bonnievale Area.—Quite recently a number of soils from the Robertson District were examined to ascertain their suitability for fruit-growing (principally apricots).

Representative samples of soil were collected at depths of one, two, and three feet respectively from four farms, all of which have a fairly large acreage under irrigation.

The soils of the Robertson District being very largely of a Karroo or alluvial origin, are in general very fertile, and have a high productive value. Being an extensively irrigated area, however, the productive life of many of the Robertson soils is more or less seriously menaced by the prevalence of an accumulation of "brak" or "alkali" salts.

The examination of the soils under discussion, therefore, was not so much concerned with their supply of the essential fertility elements as with their content of soluble salts ("brak") and the suitability of their physical composition for fruit tree growing.

The first soil from which samples were secured was a fine sandy loam of good tilth and depth and of alluvial origin. The samples were taken from the lowest lying portion of this land, which gave indications of imperfect under-drainage—a condition which is favourable to an accumulation of salts.

On analysis, the following percentages of soluble salts were found in the first, second, and third feet of soil respectively:—

	Per Cent. Soluble Salts Present.	Soluble Salts, expressed in lb., present per Acre Foot of Soil.
1st foot	·0154	616
2nd „	·0107	428
3rd „	·0108	720

In general, a concentration of .2 per cent. of soluble salts, i.e. 8,000 lb. of soluble salts per acre foot is considered as constituting a "brak" or toxic condition of the soil.

Judged by the above standard, therefore, this soil contains a low and perfectly safe concentration of soluble salts, and, furthermore, since this soil has been under irrigation for the past fourteen years, and has irrigated land lying on a considerably higher level immediately above it, from which leaching and seepage takes place into the lower-lying land, there seems no likelihood of the productive life of this soil being endangered by an invasion of "brak." The uniform physical composition and good depth of this soil showed it to be well suited for growing fruit trees.

Soil from a Lucerne Camp.—The next batch of samples was taken from a large lucerne camp adjoining the land just dealt with. The first foot of this soil consists of red Karroo sandy loam of fine texture. The second foot is comprised of a fairly close-textured clay, while below this is found a sandy loam of a very similar nature to that of the first foot of soil.

The greater portion of this land lies on the sloping ground, and the samples were taken from the centre of a fairly level stretch upon

which the sloping sides of the land converge, as this section was the most likely area for the existence of brak conditions.

The concentration of soluble salts was found to be as follows:—

	Per Cent. Soluble Salts.	Soluble Salts, expressed in lb., per Acre Foot.
1st foot	·0060	240
2nd „	·0420	1,680
3rd „	·0131	524

Here, again, the concentration of soluble salts is low, and, as this land has been under irrigation for a considerable period and its natural drainage is good, the probability of this soil becoming "brak" is very remote.

As a fruit-growing proposition, the only disadvantage this soil possesses is the existence of the fairly close-textured clay sub-soil, which commences at about a depth of a foot, and is, roughly, a foot thick. It is most probable that this would have a retarding effect on the growth of any trees planted.

In connexion with the concentration of "brak" salts at the various depths sampled in this soil, it is interesting to note that the clay sub-soil (second foot) contains the highest concentration of soluble salts. This illustrates the retarding effect of a close-textured, compact, impermeable soil layer on the removal, by natural drainage, of noxious salts from the soil. The bulk of the surface soils of the Robertson area are porous, but a great many of them have a close-textured, rather impermeable, soil layer underneath, and it is particularly in such soil layers that "brak" salts accumulate in high concentrations and which act as an effective barrier to their removal either by natural or artificial drainage.

Barley Crop Land.—Samples were next taken from a twenty-eight morgen stretch of land, which has carried barley crops for a number of years.

The first foot of this soil consists of red Karroo sandy loam of excellent tilth. The second and third feet consist of a close-textured tenacious clay.

As the whole of this land lies on a slope which flattens out somewhat at its lower end, four representative spots were chosen, and foot soil sections were taken from each spot, and then a composite sample made up from the four samples of each foot section.

The concentration of soluble salts was found to be as follows:—

	Per Cent. Soluble Salts.	Soluble Salts, expressed in lb., per Acre Foot.
1st foot	·0086	344
2nd „	·0533	2,132
3rd „	·0854	3,416

While these results reveal that in none of the samples taken is there a dangerous concentration of "brak" salts, the existence of the impervious clay sub-soil renders this soil a very doubtful fruit proposition. Here, again, in the close-textured clay sub-soil a relatively high concentration of soluble salts has accumulated.

That very good crops of barley are secured from this soil is not to be wondered at, as barley is a comparatively shallow-rooted crop, and the first foot of this soil is really excellent.

The presence in this land of numerous scraped knolls led us to secure composite samples of one and two feet depths respectively from several of these scraped areas.

Scraped Areas.—Soil levelling operations have frequently to be carried out on the agricultural soils of the Robertson-Bonnievale area, and scraped areas such as mentioned above are fairly numerous in many lands. These scraped areas have a tendency towards alkalinity, and very generally contain a much higher concentration of salts than the surrounding soil. This is due to the shallow nature of the soil on such areas, for during levelling operations commonly a depth of from four to six feet of soil is removed.

The concentration of soluble salts found in the composite samples secured from the scraped patches was as follows:—

	Per Cent. Soluble Salts.	Soluble Salts, expressed in lb., per Acre Foot.
1st foot	0·5550	22,200
2nd "	1·1100	44,400

These samples showed an excessively high concentration of brak salts.

The soil samples already dealt with were secured from farms in the Robertson area, and further samples were obtained in the Bonnievale area. In the Bonnievale area two distinct types of soil were met with. Firstly, an alluvial valley soil of a sandy loam nature and of indefinite depth. Secondly, red Karroo soil, also of a sandy loam nature, which is underlain in parts by a close-textured clay sub-soil, and in other parts by a calcareous sub-soil.

The highest concentration of soluble salts found in the samples taken was .0854 per cent. or 3,416 lb. of salts per acre foot. This concentration occurred in the clay sub-soil underlying certain sections of the red Karroo soil. In none of the other samples did the concentration of brak salts exceed 1,800 lb. per acre foot, and in a number of cases the concentrations were below 600 lb. per acre foot. Except for the Karroo soil, which is underlain by a clay sub-soil, the physical composition of these soils is well suited for fruit trees.

In all the soils examined, good natural drainage is the factor mainly responsible for maintaining at a safe limit the concentration of soluble salts.

The brak salts present in these soils were preponderantly of the "white variety," i.e. sodium chloride, sodium sulphate, and magnesium sulphate, there being little or no "black brak" (sodium carbonate)—which is the most harmful brak salt—present.

GROOTFONTEIN, MIDDELBURG (CAPE).

Sheep Awards.—Grootfontein exhibited 7 rams and 7 ewes at the Queenstown and Bloemfontein Spring Shows. At Queenstown the awards were: 1st Reserve Grand Champion Ewe, 1st Reserve Champion Strong Wool Ewe, 1st Reserve Champion Fine Wool Ram, 2nd Reserve Champion Fine Wool Ewe, six first prizes, three second prizes, three third prizes one highly commended.

At Bloemfontein the awards were as follows:—1st Reserve Leading Prize Strong Wool Ram, 1st Reserve Leading Prize Strong Wool Ewe, five first prizes, three second prizes, three third prizes, one highly commended.

Red Polls.—The small herd of red polls recently purchased for this institution will shortly be augmented by the addition of a bull and ten pure-bred cows, which are being imported from England, The introduction of this dual purpose herd for Karroo conditions will be watched with considerable interest.

Short Courses.—The short courses held during the vacation in June and July this year were extremely popular. All accommodation at the institution was fully booked up; unfortunately some applicants failed to arrive, but the number who actually attended amounted to 346, of whom 103 were women. These numbers are extremely satisfactory.

The sheep and wool, domestic science, and poultry courses still prove the principal attractions. The number of applicants for the sheep and wool courses far exceeded the number that could be accepted, but, in order to meet the position, an additonal course was arranged for the third week, so that for four consecutive weeks short courses in sheep and wool were conducted and well attended.

The excellent progress made in the formation of egg circles and export of eggs meant an increased demand for the poultry course, which is becoming very popular.

Wool-growers' Associations.—Another step was achieved in the advancement of the sheep and wool industry in South Africa at Bloemfontein during show week when the temporary executive of the wool growers' associations elected at the Conference in Middelburg in May last considered the draft constitution for a National Wool-growers' Association. This constitution, with certain amendments, was generally agreed upon, and is being circulated among various associations interested.

The rules for wool-growers' competitions were also discussed and agreed upon, and copies thereof sent to all associations. This plan of competition, which has for one of its objects the advertisement overseas of South African wools, is one which. if properly supported, should do an immense amount of good to develop the sheep and wool industry, and it is hoped that all the members of associations in South Africa will make a special effort to ensure the success of these competitions. The inter-district competitions for the Provinces will be held in conjunction with the Port Elizabeth Show in 1926, the Bloemfontein Autumn Show, 1926, and the Witwatersrand Show in the autumn of 1926; the centre for Natal has not yet been decided. The successful exhibits will be entered for the inter-provincial competition to be held in conjunction with the Spring Sheep Show in Bloemfontein in 1926.

CEDARA, NATAL.

How to Keep Milk and Cream Fresh.—The warm weather is at hand, and farmers are already complaining of their milk and cream souring, and are seeking advice on how to keep it fresh. Some of the major factors only will be considered here.

First, it is stressed that the milk must be produced in a clean place, from clean cows by clean milkers, and into clean utensils.

After clean milk has been produced, it should be cooled immediately to as low a temperature as possible by placing it, in a container, into another container with cold water, and stirring until the milk has attained the temperature of the water. Cold running water is the best. Where this is not possible, the water should be changed three or four times daily. The milk may be kept cool en route by means of wet gunny sacks wrapped round the cans. The milk must be delivered frequently, and early in the morning where this is possible.

Cream that will keep well must come from clean milk separated while the milk is still warm from the cow. The cream may be cooled in the same manner suggested for cooling milk. Too many farmers are content to stand the warm cream in the cold cellar, thinking that it will cool off there. This method of cooling milk or cream is too slow, allowing bacteria ample time to do their harm, and to grow and multiply. Water cooling is just about thirty to forty times as rapid as air cooling.

The cream-screw should now be regulated to skim a 55 per cent. cream, as rich cream has better keeping quality than thin cream.

It is important that all milk buckets, cans, and separator parts should be thoroughly cleaned and sterilized. Sterilization on the farm can readily be done by placing utensils in a large pot or some kind of boiler over an open fire and leaving them to lie in the boiling water at least fifteen minutes. They should then be taken out and left to dry in a sunny place, free from dust. The sun is our cheapest disinfectant.

Three important factors are emphasized: (1) cleanliness; (2) sterilization of utensils; and (3) thorough and immediate cooling.

GLEN, ORANGE FREE STATE.

Pig Experiments at Glen.—The experimental work being carried out, of which the results will be published in due course, is as follows:—

1. Sunscald in pigs. The Farmers' Co-operative Bacon Factory, Estcourt, Natal, has very kindly donated two Middle White gilts to the institution for this purpose.
2. Balanced *versus* unbalanced rations. One lot is receiving a ration of maize-meal plus meat-meal, and the other lot maize-meal only. Both lots are getting succulent food.
3. Food costs of raising pigs: (*a*) pure-bred; (*b*) cross-bred.
4. Self-feeding *versus* hand-feeding.

Trouble Experienced when Cutting Sunflowers for Silage.—The silage crop last season consisted of sunflowers and mealies. Difficulty was experienced, even with a new silage cutter, in getting the machine to deliver the cut material into the silo, without stoppages caused by the delivery pipe becoming choked. When the sunflowers, immediately after being harvested, were carted to the silage cutter and put through the machine, no trouble was experienced. If, however, the sunflowers were allowed to wilt or become rain-soaked it was found to be almost impossible to run the machine on account of the delivery piping becoming obstructed. The trouble was due to the sunflowers, since when mealies only were fed the machine gave very little trouble. It is advisable, therefore, when making silage from sunflowers, to get them through the silage-cutter as soon as possible after harvesting.

Depth of Ploughing Experiment.—An experiment to ascertain the best depth to plough on dry lands has been carried on at Glen since 1921. The depths of ploughing are approximately 4, 7, and 10 inches. Four different crops, viz., maize, sunflowers, Amber cane, and Sudan grass, are grown each year on the same soil, and the results are determined by the yields of green forage, cut at a stage suitable for silage, and also, when possible, by the yields of maize grain. There are 72 fortieth-acre plots.

With one or two exceptions, the results have been in favour of deeper ploughing, the advantage being especially marked in the case of sunflowers (for silage) and maize (for grain). Owing to the limited rainfall, it was unfortunately only possible to reap maize for grain during two seasons. A summary of the results of the experiment is given in the following tables:—

A. *Yields of Silage Crops* (Maize, Sunflowers, Amber Cane, and Sudan).

Approximate Depth of Ploughing.	Average Yield of Green Forage in lb. per Acre.					Increase in Yield over 4-inch Ploughing.
	1921–22.	1922–23.	1923–24.	1924–25.	Average of 4 Seasons.	
4 in.	2,985	13,316	16,036	8,938	10,319	—
7 „	3,025	13,854	15,947	11,154	10,955	6·6 per cent.
10 „	3,604	14,834	17,116	12,066	11,905	15·3 „

B. *Yields of Maize* (Natal 8-Row).

Approximate Depth of Ploughing.	Average Yield of Grain in lb. per Acre.			Increase in Yield over 4-inch Ploughing.
	1922–23.	1924–25.	Average of 2 Seasons.	
4 in.	1,664	1,055	1,360	—
7 „	1,829	1,330	1,580	16·2 per cent.
10 „	1,901	1,509	1,705	25·4 „

C. Particulars of Ploughing, etc.

Season.	1st Ploughing.		2nd Ploughing.		Other Cultivation before Planting.	Date of Planting.	Remarks.
	Date.	Depth.	Date.	Depth.			
1921–22	7th December, 1921	4 in., 7 in., 10 in.	—	—	Harrowed, 12th December, 1921	15th December, 1921	Very dry season. Crops dry at harvest.
1922–23	5th June, 1922	All plots 4 in.	10th November, 1922	4 in., 7 in., 10 in.	Harrowed, 12th October, 1922 Harrowed, 11th November, 1922	16th November, 1922	Good fairly even rainfall.
1923–24	5th June, 1923	4 in., 7 in., 10 in.	19th November, 1923	All plots 4 in.	Harrowed, 21st November, 1923 Disced, 24th January, 1924	30th January, 1924	Heavy rainfall during growing period.
1924–25	9th October, 1924	4 in., 7 in., 10 in.	—	—	Harrowed, 13th October, 1924	10th November, 1924	Too dry to plough in winter. Latter half growing period fairly dry.

Cheese Investigations.—During the past season samples of cheese from various factories in the country were submitted for bacterial investigation. In most cases a very unpleasant, bitter taste was present, with a variety of other "off" flavours. In several instances an organism (*Streptococcus liquefaciens*) was isolated from the defective cheese. This organism produces a very bitter taste in milk. It first of all coagulates it and then digestion takes place. The natural habitat of this organism is in manure, and its presence in milk indicates that not sufficient cleanliness and care are exercised in the production of the raw product.

Although cheesemakers are often to blame for the manufacture of inferior cheese, it can hardly be expected of them to produce a first-grade article from milk in which various undesirable fermentation processes have taken place, and in which organisms are present that exercise harmful influences on the cheese during curing.

During the slack season cheesemakers would be well advised to visit the suppliers and to advise them in the cleanliness and care so necessary for the production of milk suited for cheesemaking.

A Dangerous Weed.—The Russian Tumble weed (*Salsola kali*), also known as the Russian Thistle, has been proclaimed a noxious weed in the Orange Free State, and farmers of that Province should give special attention to the description of the weed published in the September, 1925, issue of this *Journal*. The plants should never be allowed to develop seed. In newly infested lands the young plants may be ploughed under.

POTCHEFSTROOM, TRANSVAAL.

Mating.—For lambing in March and April, the rams should be put with the ewes this month. The usual number of rams is two to three for every 100 ewes, leaving them in for about eight to ten weeks. Economy in the use of rams does not pay, and there is probably no expenditure that will give better results than money spent on rams purchased from a first-class flock.

Do not breed from ewes under eighteen months, otherwise growth is retarded, and the animals will deteriorate in size and vigour. A higher percentage of lambs will be obtained if the ewes are shorn. The rams are shorn a few months prior to mating. Ewes in good condition come in season more readily than poor sheep. It is advisable to have a piece of spare veld to put the ewes in for a time before mating. This will ensure that they are in a growing condition, which is desirable for the best results. Failing good green veld, grazing on oats shortly before mating will bring the ewes in the condition required.

Rams at this time should also have the best of treatment, and for the best results it is advisable to give a certain amount of hand-feeding prior to mating. A double handful of the following mixture, given twice a day to a working ram, will be found very beneficial: Crushed oats, crushed mealies, and soaked peas.

THE AGRICULTURAL PROBLEM IN SOUTH AFRICA.

By THE RT. HON. SIR HORACE PLUNKETT, K.C.V.O., F.R.S.

FOREWORD.

The following pages are written in the belief that the welfare of South Africa—of its urban no less than its rural population—depends upon the development of agriculture and the subsidiary industries. In them I submit for the consideration of statesmen and public-spirited citizens certain definite proposals for the attainment of that end. It is true I was but six weeks in the country, not long enough to know much about it—rather too long to write a book! Considerations of health prevented my travelling far from Capetown. On the other hand, as Parliament was in Session, I was fortunate enough to meet representative people from all the Provinces and Rhodesia. The Department of Agriculture placed all the information I required at my disposal; the Registrar of Co-operative Societies and the General Manager of the Land Bank actually came all the way from Pretoria to help me in my inquiries.

A few incidents of my stay may be mentioned. On 26th February, by arrangement with the Government and the Opposition Whips, I was enabled to meet in conference members of both Houses, Mr. Speaker doing me the honour of presiding. There we discussed fully the legislative and administrative aspects of the country's agricultural policy. A few days before I had delivered an address at Paarl upon the organization of agriculture, to which the Press gave considerable publicity. On 11th March I had a conference with the Advisory Council of the Ministry of Agriculture. Many whose wishes I could not disregard asked me to embody my views in a comprehensive memorandum, which would provide a basis for future discussion and, possibly, lead to action in a large way.

This I did, and submitted the document to General Hertzog, Prime Minister, who must not be supposed to be committed to any of its contents. He, however, asked me to send it also to his predecessor, General Smuts, a sufficient proof that the question treated is regarded as being outside the domain of party controversy. The memorandum was hastily put together during my last days in South Africa, whence I sailed on 20th March, 1925. On the homeward journey I found that the work was not well done, and I decided to amend it into its present form. I delayed its completion until I had met the party of S.A. farmers who came to Europe in the summer months. Although it was thus somewhat lengthened, I think its aim and purpose will be much more easily understood.

HORACE PLUNKETT.

The Horace Plunkett Foundation,
435-437 Abbey House,
Westminster, London, S.W. 1,
20th July, 1925.

THE OUTLOOK FOR A WHITE SOUTH AFRICA: ITS DEPENDENCE UPON AGRICULTURE.

1. The future of South Africa is causing grave anxiety to all who have gone deeply into the problems with which its people are faced. The Census of 1921 (a mine of information and suggestion most creditable to Mr. C. W. Cousins, the Director of Census) shows that the European population, which ought to increase and multiply and replenish the earth, is not holding its own with the natives and other coloured races. But for the ravages of influenza among the latter in 1918, the figures would have been alarming. The country has long been accessible to white immigration from the old world and the new. Yet the white population, three out of twenty of whom were, as the Census points out, born outside the Union, barely exceeds a million and a half, as against a non-European population of close on five and a half millions. Last year eight hundred more white people left South Africa than came to its shores. But to me the worst sign of the times was the emergence of a "poor-white" problem, which suggests that coloured labour may be dragging down a portion of the Europeans, as happened in the Southern States of North America in somewhat analogous conditions.

2. In view of these facts, it may reasonably be feared that western civilization will here be its own undoing. The native races are no longer allowed to make war upon one another, and medical science will prevent the diseases which are nature's cruel remedy for over-population.* If things are allowed to drift, a rapid increase in the numerical predominance of non-Europeans must result. Mr. Cousins estimated that after two more Census decades we shall have a European population of 1,800,000 beside a non-European population of 12,000,000. Whenever a leader, capable of stating their case effectively, arises among the latter—or, as is perhaps more probable, comes to them from outside—they may become class conscious and organize their labour. A consideration not to be ignored is that world opinion, which can no longer be regarded as a white monopoly, is becoming insistent upon majority rule and self-determination as political principles. These are wholly inapplicable in the existing conditions; but it were surely wiser to rely upon a clear proof that, even in the interests of the non-Europeans, the present régime is justified than to maintain it by force. If the definite proposal I have to make were given practical effect, this claim would be established to the satisfaction of all the inhabitants of South Africa and the opinion of the world.†

3. Whether or not any such considerations will move public opinion, it seems to be unanimous upon the essential necessity of developing to the utmost the agricultural resources of the country and encouraging by every means the settlement of white communities upon the land. But for the recent discovery of minerals other than gold and diamonds, the need for a larger agricultural population

* "The native owes the comparatively slow rate of natural increase to a phenomenally high infantile death rate" which may soon be remedied. Census Introduction, p. 24.

† In support of this interpretation of the civilized world's best opinion upon this matter, may I not cite Article XXII from the League of the Covenant, which mentions peoples who are "not yet able to stand by themselves under the strenuous conditions of the modern world," and whose "well-being and development is a sacred trust of civilization"?

would have been more generally realized. Beyond question this is urgent; for even if these new mineral resources were supplemented with large deposits of coal and iron in juxtaposition, agriculture would still have to provide the wealth upon which alone an enduring national prosperity can be built. The cities would still require for their own well-being a large and prosperous population in their agricultural hinterland, supplying them, on the one hand, with a larger variety of produce, and, on the other hand, providing a home market for their manufactures and imported commodities. In other words, without a much greater number of European families upon farms, there will be no prosperous and progressive South Africa, even if you might have for a few more years a country where, in the prophetic words of Goldsmith, "Wealth accumulates and men decay."

4. Settlement of the kind required is being actively promoted by philanthropic and commercial agencies and individuals. Notwithstanding these efforts, it was the general opinion that, unless the occupation of farming can be made more remunerative and attractive, the proportion of white farmers will not be materially increased. To supply this condition in time to meet the needs of the situation presents a business problem of great complexity, to which it will take the best business brains of the country to find a solution. I shall, therefore, address myself not only to farmers but still more to public men in other walks of life. A few words must be said in explanation of this unusual method of approach to what I ask my readers to regard as the most urgent of national problems in South Africa.

5. A long and wide experience of work among rural communities has taught me that, even in countries where the political influence of the agricultural class is predominant, the effective public opinion which must be convinced before there can be an adequate agricultural policy must be looked for in the cities—their Press, their teachers, their preachers, their lawyers, and, stranage as it may seem, their industrial and commercial leaders. The explanation of this paradox is simple. Farmers use their political influence for the satisfaction of their immediate needs as they see them. They do not dictate, as they should, the agricultural policies of governments, simply because *they do not think in terms of policies*. They have, for example, no clear idea of the respective functions of State aid and private initiative in fostering their industry and protecting their interests; so they expect too much to be done for them. They do not realize that, when the Government has done for them all that it legitimately may, they will still have to modernize their business methods before they can be prosperous. Not realizing the full significance of these fundamental considerations, they will not make the needed reforms of their own initiative. I believe they would respond to the leadership I am suggesting. So, without further introduction, I will sketch the agricultural situation in South Africa as I saw it, indicate its weak spot, and suggest a plan by which it can be remedied.

SOUTH AFRICA'S AGRICULTURAL RESOURCES: THEIR POTENTIAL DEVELOPMENT UNDER EUROPEAN CONTROL.

6. There is no need here for a detailed survey of the country's agricultural resources. A host of witnesses assured me of their

abundance. Maize, they told me, is the staple crop. Given the right breed of pigs and a greatly increased cultivation of lucerne, an export bacon trade might be capable of rapid development. Fruit, we know, might be marketed more advantageously and furnishes the raw material of many actual and potential industries.* South African tobacco has attracted the attention of one of the world's biggest industrial organizations. Some districts are favourable to the dairying industry and the manufacture of milk products. The production of poultry and eggs should be universal. Cane-sugar can be grown in Natal and Zululand, and manufactured on a large scale. Beef production for export is not on the programme at present; but I have seen many cattle whose chief value must be their hides, furnishing the basis of leather industries. Sheep, I am told, could be greatly increased with a view to larger wool export, and possibly a home development of a woollen manufacture. Of cotton industries I know nothing, but many people think they have a bright future in South Africa, both for this crop and its by-products. And then there are ostriches, which supplement diamonds in the adornment of womenkind.

7. The country has too lately emerged from its pioneer stage for any final decision to be taken as to those potentialities, of which I dare say my list is very far from complete. At any rate, these questions are for experts. Those I consulted satisfied me upon the abundance and variety of the agricultural resources awaiting development. Probably there might be many more irrigation projects. There is no lack of cheap labour. I believe this might be better paid if it were better educated, with advantage to the employer. But the main consideration I desire to emphasize is this: The agriculture is so diversified—so technical in many of its branches and in its subsidiary industries—that its successful exploitation depends absolutely upon the technical skill and organizing capacity of the British and Dutch farmers. The marketing of the greater part of the product is in Europe, 6,000 miles away, so that efficient distribution, no less than efficient production, is beyond the reach and ken of the native races. In the circumstances, the economic justification for the white man's domination is complete, provided he does well the duty assigned to him.

A CRITICISM OF SOUTH AFRICAN FARMING.

8. The system under which the agricultural resources are being developed leaves much to be desired. The critic of South African farming must not fail to take account of the exceptional difficulties with which the farmer has to contend. The country has more than its share of animal and plant diseases, which may be counteracted, and of droughts and floods, which, although conservation of water might probably go much further, are beyond human control. But when all is said, making full allowances for peculiar local difficulties, to the sympathetic outside observer South African farming presents a strange paradox. On the one hand, I know no country where the Government is doing more to help the farmer. The Ministry of

* The home market for the best fresh fruit is no doubt limited but it should not be neglected. A stranger coming to Capetown finds it odd that he cannot get as good South African fruit as is displayed in the West End of London.

Agriculture has long been noted for the efficiency and devotion of its administrative and expert staff. The legislation for the promotion of co-operation, to which I shall return presently, constitutes one of the most advanced agricultural policies in the British Commonwealth. The Land Bank seeks, with combined caution and liberality, to provide a sound system of agricultural credit. Furthermore, in the region of voluntary efforts, as distinct from official activities, the country is well supplied with co-operative organizations of one kind and another. To these a large section of the farmers nominally belong; but too often they only patronize them when they cannot do as well with commercial agencies competing for their business. Again, many individuals, in some cases captains of industry of world reputation, have become "cheque-book farmers." Some of them conduct experiments of considerable educational value.

9. Yet in the typical farming communities of the Union you still find the members individually transacting the bulk of their business with highly-organized interests. One result of this anomaly is that they buy everything they require in their industry at retail and sell what they produce at wholesale prices—not a get-rich-quick procedure. Commonly the seller *to* the farmer and the buyer *from* the farmer are one and the same individual! When these primitive husbandmen need working capital, they raise it by short-period loans, suitable no doubt to city business, with its quick turnover, but wholly unsuitable to agriculture, which has to wait upon the slow processes of nature.* A good authority told me that, notwithstanding the existence of the Land Bank and the farmers' co-operative organizations, at least three-quarters of the farmers in the Union are deeply in debt to the storekeeper who transacts their buying and selling business on credit. Even if he charges no interest on overdue accounts, when the figures debited and credited in these tied transactions are taken into consideration, the actual interest exacted would make Shylock green with envy. Yet, after making the solvent farmer "pay through the nose" for the default of the insolvent, the trader is often impoverished by bad debts. The system is vicious, bad for all parties, and disastrous to the nation.

THE ESSENTIALS OF AN AGRICULTURAL POLICY: THE WEMBLEY CONFERENCE.

10. Summarizing this rough survey of the agricultural situation, we find that there is an abundance of natural resources and that the country has, as I have intimated, a very advanced scheme for their development. The one weak spot is that the primary producers are not supporting the Government scheme, or even their own organizations, as they should. That is because they do not understand the agricultural policy, which, in its essentials, could hardly be improved. Upon this I must be explicit, because it has an important bearing on what I am about to propose. Moreover, the business men, whose assistance is so necessary, cannot be expected to have given much attention to the details of the policy. I shall try to make it interesting to them.

11. The policy may be said to have had its origin in Ireland; for I may remind South Africans that the co-operation on which

* I return to the credit question below. (Par. 15.)

it is based was initiated by a certain Irishman whom I often heard referred to as "Paddy Hannon." He had been trained by the Irish Agricultural Organization Society and brought to South Africa by somebody representing Doctor Jameson. He founded many co-operative societies, most of which failed badly. Yet I was told that this organizer did more good by popularizing "köperasie" than he did harm by his failure to organize them on sound lines. But we may pass by this episode and come to a more recent date, when the policy received an unqualified endorsement by as authoritative a body as it would be possible to consult.

12. A conference upon agricultural co-operation, which is the outstanding feature of the Union's policy, was held at the Wembley Exhibition in July, 1924. The leading agricultural organizations in the British Isles and the Dominions, and nearly all the Governments concerned, including that of South Africa, were represented. The British Minister of Agriculture presided over the opening session. Before it came down to its practical work, the conference embodied in a resolution the fundamental principles of what it held to be the agricultural policy best suited to the countries represented. The resolution, after declaring the vital importance of "a prosperous and progressive agriculture," continued:—

> That agricultural prosperity depends fundamentally upon the fulfilment of three conditions:—
>
> (1) The application of scientific knowledge under the guidance of the State to the farming industry;
>
> (2) the voluntary organization of farmers for business purposes on co-operative lines; and
>
> (3) a reconstruction of social life in the country, with a view to removing the disparity between the respective attractions of town and country.

Here you have an expansion of the Irish formula: *Better farming, better business, better living*. It might well be adopted by South Africa, because it is wholly applicable to that country's agricultural policy.

13. The peculiarity of the policy embodied in this resolution is its comprehensive treatment of the rural problem, and the importance it attaches to co-operation. It regards and insists upon treating agriculture from three points of view: as an industry, as a business, and as a life. The industry is to be improved by bringing to bear upon it, as has been done in all other industries, the teachings of modern science. This is admittedly a proper function of Government. Secondly, the improvement of the farmers' business methods is to be achieved by organizing farming communities for every business purpose. By this means alone can these communities be placed in a position to combine whenever combination pays better than individual action, as it almost always does in modern business. The combination must be upon co-operative and not upon joint-stock lines,* and, for reasons I shall give presently, the initiative must

* In Britain and Ireland nearly all co-operative associations are registered under the Industrial and Provident Societies Acts or the Friendly Societies Acts. Under the former limited liability is always the rule, as in the ordinary Joint-Stock Companies. In South Africa, the term Co-operative Society implies unlimited liability, the term Co-operative Company, limited liability. This note is, of course, for other than South African readers.

be with the farmers themselves and not with the Government. Lastly, the life of farming communities must be improved through the provision of social amenities which will counteract the "lure of the city," otherwise none but the dull and unenterprising will stay upon the farms. Here both governmental and voluntary initiative is required. It is for the Government to see that rural education is redirected for the purpose in view. The task of creating and supplying a demand in the rural community for social and intellectual advancement should be taken up by some of those who devote their lives to social service in the cities. It is worth mentioning that in wireless we have a new agency of social service, the possibilities of which, in brightening rural life—to say nothing of useful information upon weather, markets, etc., and educational uses—are hard to exaggerate. In this matter the country clergy might give a lead, but for my present purpose, which is to interest business men in the business factor in rural progress, I may concentrate on "Better Business," and leave aside "Better Living" for consideration at a later stage.

THE FUNDAMENTAL IMPORTANCE OF CO-OPERATION IN AGRICULTURE.

14. To give practical effect to this policy, with its threefold treatment of the occupation of farming, an important working principle has to be observed. The *co-operative* organization of the entire farmers' business—at the producing end, in the transport of produce, and in its sale in the market—is treated as an essential condition of agricultural prosperity. Farmers must be so organized in their business that they, and not a horde of superfluous middlemen (who are as injurious to the necessary distributors as to the farmers) will profit by the increased production resulting from the application of science to their industry. Unless the primary producers are properly organized, they simply won't take advantage of the educational and other assistance offered to them by the Government. This work, no matter how efficient, is then robbed of half its fruitfulness—and, incidentally, a large part of the money with which it is financed by the general taxpayer is wasted. The other reason for beginning with the organization of co-operation is not so obvious. Experience shows that, until farmers have learned to come together in the business of their lives, and have found it to be for their mutual advantage to do so, they cannot be induced to combine for the higher purposes of intellectual and social advancement. The co-operative system brings order out of chaos in the business of the rural community; the co-operative spirit humanizes its life. It must, therefore, be borne in mind that, in working out our formula, *Better Business* will be the foundation of *Better Farming* for one reason and of *Better Living* for another.

15. Schemes for such an all-round organization of the farmers' business, as is now admitted to be necessary, have so far been successful in proportion as they have been founded upon a sound business organization of the primary producers. Unless this foundation is well and truly laid, co-operative federations for the marketing of farmers' produce cannot be sure of regular, standardized supplies, without which they cannot compete with outside commercial firms,

who are in a position to deal with the most efficient producers. These firms do not hesitate to buy off the best suppliers of the co-operative associations, with the ulterior motive of nipping the co-operative movement in the bud. There is another practical reason for the co-operative organization of the primary producers which is too often overlooked. Farmers must have working capital upon terms suitable to their industry, and they must be able to raise it without mortgaging their farms; that security should be pledged only for permanent improvements which will add to their selling value. Equally objectionable, as a means of raising money for short terms, are bills backed by the substantial members of co-operative societies.* In a well-organized co-operative society, a new security upon which the members can borrow becomes available. A member wishing to borrow from his society, can do so, provided he requires the money for a "productive purpose"—that is, a purpose which, in the opinion of the board or committee of the society, will enable the borrower to repay the loan, principal, and interest. It is a good plan to form a "co-operative credit society," in which the members are jointly and severally liable for its debts, for the sole purpose of raising money for farming operations. The society then takes care to admit no member who is not of good character and also a competent farmer. In short, co-operation provides a security, which consists in the knowledge by the society of the character and business capacity of its borrowing members, and of the purpose for which the money is required. The ordinary commercial lending agency has no means of knowing these things, and, as I have said before, only lends to farmers on terms suitable to the business of the city.†

THE CONTRIBUTION OF THE WEMBLEY CONFERENCE TO THE PROMOTION OF AGRICULTURAL CO-OPERATION.

16. I must not pass away from the Wembley Conference, which gave a fresh turn to thought upon agricultural co-operation, without noting a remarkable feature of its discussions. These home and overseas suppliers of the British food demand, instead of fearing each other's competition as some of us thought they would, took exactly the right view of their mutual interests in a market which would take all the British Commonwealth had to give and cry out for more. They recognized that they could not hope for tariffs on food; but all British parties would be glad to discriminate in favour of the home grower and Dominion producer, provided the price of food was not raised thereby. But without any governmental aid much can be done. For example, the New Zealand dairy producers and the English Co-operative Wholesale Society have established the most beneficial and efficient business relations. With still

* Throughout I use the term society (and societies) for any and all co-operative associations.

† The Rural Credit Bill, introduced in the 1925 Parliament, made full provision for the organization of Credit Societies, on the lines indicated in this paragraph, by the Land Bank, of which they were to become virtually branches. That institution is very ably, and at the same time sympathetically, administered by the Managing Director, Mr. Thomas B. Herold, and his staff. I hear that it is establishing a branch in London to serve this and other European marketing centres, which looks to the outsider a step in the direction of linking up co-operative distribution with co-operative production.

wider scope we have, in the Overseas Farmers' Co-operative Federations, Ltd., an agency ready to sell Dominion produce co-operatively in the British markets. Under the able management of Mr. A. E. Gough, it is steadily increasing its turnover. The conference realized that the work done co-operatively at the marketing end, and any help the British Government could give, would depend for its success upon better co-operative organization at the producing end. Upon this aspect of the subject, as I must now explain, it did some thinking of a very practical kind.

17. The conference had been convened by a body of trustees, to whom I had handed over my life work of agricultural development and rural reconstruction—mainly through the organization of co-operation. The following resolution demanded of them a further service by which the work of the conference is to be continued. It was unanimously resolved:—

> That, in view of the importance and urgency of reliable information as to the position and progress of the agricultural co-operative movement in all its branches, there should be established in London a clearing-house of such information for the service of the movement primarily throughout the English-speaking world.
>
> That the Trustees of the Horace Plunkett Foundation be hereby asked to consider steps to give effect to the above resolution.

The Trustees of the Foundation (which, the reader will now see, they christened with my name) have thus had thrust upon them the duty of attempting to co-ordinate the agricultural co-operative efforts of the entire British Commonwealth from the office in London, which has been duly made a clearing-house for that purpose.*

SOUTH AFRICA'S EXPERIMENT IN COMPULSORY CO-OPERATION.

18. Important as it is to take a wide view of agricultural co-operation and study its progress in other countries, I must now concentrate upon the co-operative movement in South Africa I have already adverted to the "Paddy Hannon" incident. I come now to a more serious contribution to the rural problem. In 1922, Sir Thomas Smartt (an Irishman, I am glad to note), whose devotion to the farmers' interests and enthusiasm for co-operation are notorious, piloted through Parliament a remarkable law, which is before me as I write. It was officially described as an—

ACT

> to provide for the formation, registration, and management of co-operative agricultural societies with unlimited liability, co-operative agricultural companies with limited liability, and co-operative trading societies with limited liability.

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* The Report of the Conference is pub ished by George Routledge & Son, Limited, 10s. 6d. net. The two resolutions I have quoted will be found on pages 137 and 222 of the Proceedings.

Readers wishing to inquire of the Horace Plunkett Foundation or join its Associate Membership, should write to the Secre ary, Mr. K. Walter, Horace Plunkett Foundation, 435–437 Abbey House, London S.W. 1. The Premier of South Africa is an Associate Member.

The title makes an old-fashioned co-operator rub his eyes. To him it is of the essence of co-operation that it should be spontaneous in its inception and, as far as possible, voluntary in its working. While we see here that public opinion in South Africa must be convinced of the saving grace of co-operation, it admits of the intervention of the Government to the extent of applying compulsion to make the members of a voluntary co-operative society obey its rules. But let me pass from the implications of the title of the Act and come to those of its contents which appear to me to be too great an interference with private enterprise.

19. The Act defines in the most minute detail the whole duty of the co-operative man to his neighbour. It provides in its First Schedule model regulations for the three classes of co-operative organizations mentioned in the title. For every conceivable offence against the letter and spirit of co-operation it inflicts penalties which would, I should have thought, deter any farmer who had read and understood the Act from becoming a co-operator. In my conference with legislators at the Parliament House, I could not resist quoting this gem of a clause:—

> 66. Any person who, where no penalty is expressly provided, fails to comply with any requirements of this Act within the time or in the manner therein prescribed or commits any other contravention thereof, shall be liable on conviction to a fine not exceeding twenty-five pounds.

The Devil prompted me to compare this clause with Browning—

> There's a grand text in Galatians:
> Whoso trips on it entails
> Twenty-nine distinct damnations;
> One sure if another fails.

20. I say the Devil prompted me because, in the circumstances, this orgy of coercion was probably justified. Real co-operation among the primary producers was an urgent need which should be supplied at all costs. Moreover, in my conference with the Agricultural Council, a strong case was made for compelling the minority to join up with the co-operative organization of any district where a large majority had been co-operatively organized for the control of the marketing of some important commodity for export. On the other hand, I found that thoughtful people doubted the desirability—and, indeed, the practicability—of compulsory co-operation. It certainly would not be justified if there were some efficient voluntary agency which specialized in the organization of farmers, was competent to instruct them in the technique of co-operation, and could imbue them with the co-operative spirit. I am convinced those are right who hold that, where the co-operative spirit does not exist, compulsion will be evaded; where it does, it will be superfluous. You may compel children to go to school, and they will learn. If you compel adults to go to church, they will swear. Moreover, it is easy to see how compulsion of this kind will be defeated. Alongside of the protected and policed marketing organizations, will be carried on a big business through the ordinary channels of trade. Powerful commercial firms will demonstrate that they can do better for large individual producers (who are not all "cheque-book farmers") than the co-operative federations can do for them. The co-operators by compulsion

will agitate for freedom of action; the whole co-operative fabric will collapse—and with it the hope of a white South Africa.

THE IRISH PLAN OF VOLUNTARY CO-OPERATION.

21. The question is of such vital importance that I must supplement my argument for voluntary organization by telling the story of agricultural co-operation in Ireland, when she was part of the United Kingdom. Until the last few years the English people worshipped the doctrine of *laissez faire*. State interference with business was anathema. The agricultural co-operative movement began in Ireland as far back as 1889, and was the work of a few enthusiasts. From the outset the plan was to organize local groups of farmers for the erection and operation of creameries and bacon factories, the purchase of agricultural requirements, and the marketing of produce, for co-operative credit and insurance, and many other purposes. That was the first and by far the most difficult stage of the movement; at the same time it was the most important. The second stage consisted of linking up these groups into federations for larger business transactions. We looked forward to a third stage, which is now beginning, when the farmers would grasp their problem in its entirety, do their part in working out their three-fold formula, and so win for the agricultural interest its proper place in the national economy. It may be worth mentioning that, as it was essential to the success of the scheme that all members of the farming communities should join co-operative societies, every co-operative organization had in its constitution a rule excluding matters of religious and political controversy from its discussions. To the strict observance of this rule for a quarter of a century may be attributed the brilliant success of the Irish movement, up to the time when the world war, and its aftermath of civil war, temporarily dislocated our work. The Government of the Free State is, I have every reason to believe, wholly in accordance with the general principles I have explained. They know that their agricultural policy, which is nationally as important as is the agricultural policy of South Africa, cannot add to the economic strength of their country unless the farmers understand and practice co-operation. They have their eyes on South African co-operative legislation, and that is one reason why I am so anxious to take counsel with the statesmen and agricultural leaders of that country upon the fundamental issue I am discussing.

22. To go on with my story. In 1894, when the work in Ireland was progressing so rapidly that it was beyond the resources of the few pioneers, we invented a new agency of social service for the purpose we had in view, now widely known as the Agricultural Organization Society and copied in several countries. The I.A.O.S. (as the society is commonly called in Ireland) was at first managed by the original promoters; but the management passed automatically into the hands of the societies it formed. It did not trade: its function was purely educational or propagandist, the organization of farmers being included in these terms. It maintained a staff of organizers to instruct farmers how to form and register societies, and how to conduct them in accordance with the letter and spirit of their rules. We know now that it is not enough for an organizer to

have an enthusiasm for his task and the gift of influencing popular audiences. He must, in addition, have four special qualifications. He should be educated in at least the elements of agricultural science, so that he will support intelligently the technical officers of the Government's agricultural department; he should understand agricultural economics, including the keeping of accounts (with special regard to "costings" and marketing); he should be a practical farmer, preferably one who is known to have farmed to a profit; and, lastly, he should know thoroughly the technique of co-operative organization. In a few years England, Scotland, and Wales had each its Agricultural Organization Society, which worked in the Irish way. The agricultural co-operative movement in South Africa is seeking the same end by other means.

A PLAN FOR PERFECTING SOUTH AFRICAN CO-OPERATION.

23. Whatever views may be taken of the relative merits of compulsory and voluntary co-operation, all thinkers on the subject will prefer the latter, provided it can be made effective. I believe it can, and the plan I have to suggest is based on this belief. I have more than hinted that the weakness of the South African co-operative movement is due to building, so to speak, from the top, and not making sure of the foundations by the education and organization of the primary producers. This work should now be undertaken by the best substitute that can be found for a South African Agricultural Organization Society. Whether there is any existing agricultural union or association which would have the necessary influence with all kinds of farmers for the purpose in view—and, if so, which body should be selected—I do not know, and would not say if I did. It would seem to me that the best plan would be to hold an early conference at the most convenient spot for representatives of them all to meet, and then and there to decide upon the course to be taken. Naturally, if I were at such a conference, I should put in a plea for the Irish procedure. The hope of some such happening, I may as well confess, was at the back of my mind when I described in such detail the beginnings of the agricultural co-operative movement in my own country—a movement from which England, Scotland, and Wales were not too proud to learn, and which President Roosevelt on more than one occasion publicly commended.

24. In case this view should find favour among the agricultural leaders in South Africa, I will briefly state one *general* and one *working* principle it would be essential to observe in order that the urgent need of the situation may be recognized and supplied by those who, I have attempted to prove, hold the future prosperity of the country in their hands. Whatever governmental compulsion may be later resorted to—and the plan would have largely failed if that became necessary—the organization of the primary producers must be done by themselves, with the friendly counsel and advice of their leaders, and not by the Government. There are many reasons for this precaution; I will give a few. You cannot teach farmers to combine for such objects as buying at wholesale and selling at something nearer retail prices than now prevail without an interference with existing trade interests, politically well organized. It is true that

trade as a whole profits by the larger consumption of general commodities which follows upon the proper organization of farmers. But all the same, there is temporary disturbance of local trade, the Government gets into trouble, and the work is blocked. Secondly, civil servants cannot specialize for this work and could not be expected to have the qualifications of an agricultural organizer as I have described them above. Thirdly, in proportion as the Government succeeded in organizing farmers, they would increase the demand for their technical services, and the funds for this essential work would be depleted. One more objection to organization by the Government—and perhaps the most important. It weakens the sense of responsibility and destroys private initiative in farming communities. Better Farming is the function of the Government—not Better Business. That is the shortest way of putting the general principle which prefers voluntary to official agencies in charge of agricultural organization.

25. The working principle is so simple that it might well be overlooked; yet it is vitally important to the success of the scheme. The surest and *quickest* method for organizing farmers in a large way is to begin in a small way. If it were attempted to extend the work of organization to all the districts from which the big federations draw their members and their trade, an inadequate service might be given over a large area; to use a familiar simile, the butter would be spread too thin. The difficulty could be surmounted, and the future of the movement assured, by an intensive campaign of co-operative education and organization, restricted in the first instance to a few typical farming communities, say one in each Province. If sufficient organizers with the necessary qualifications and proficiency in the language of the community in which they work could be found immediately—and both Mr. Du Toit, Permanent Secretary of the Department of Agriculture, and Mr. Lamont, of the Elsenburg School of Agriculture, told me that they could—it might be well to concentrate on more than one district in the larger Provinces. By this means could be given a few living demonstrations that, through co-operative organization the industry, the business, and the life of the farming communities can be radically improved. If South African farmers have the familiar rural mentality, they will not be much impressed by such a demonstration in Denmark, Ireland, the United States, or any other country than their own. But a challenge to *all* rural communities in South Africa to do as *some* have done should be effective.*

26. To go further into details than is necessary to explain the scheme in its broad principles, gleaned from a long and toilsome experience in other countries, would only irritate those whose local knowledge will tell them how much of it is practicable and by what means. But I have one more thing to say. I have the authority of the Trustees of the Horace Plunkett Foundation to offer their services in

* I do not ignore the difficulty of the lonely, scattered back veld farmers, of whom certainly one of the groups selected for the initial experiment should be composed. The long distance between farms in South Africa, and some other countries, is one of the difficulties constantly brought to the notice of the Foundation. Cheap cars and use of telephones (and soon, I hope, wireless) should be considered by organizers as a means of counteracting the disadvantage of inability to hold even the minimum number of necessary meetings.

a way which might be helpful. The proposal being, in effect, a substitution of voluntary effort for governmental initiative and control, it will be of the first importance to uphold the authority of the Government in so far as the functions of the Registrar of Co-operative Societies must be preserved. It will also be the duty of organizers to make sure that farmers when organized utilize more fully than before the Department of Agriculture's expert teaching and advice. The Foundation would be glad, if such an addition to the cost of the experiment could be provided for, to send out for a brief period a man who has dealt with similar situations in equally complicated and difficult conditions, and who has had to co-ordinate the governmental and the unofficial bodies concerned. He would be of great help to the organizers in regard to the technique of co-operative organization, of which at first they would probably have a good deal to learn. They should have impressed upon them the relative importance of the complicated rules and regulations set out in the First Schedule of the Act of 1922; otherwise they will only confuse farmers with a mass of detail. I estimate that from six months to a year would be required to make the necessary impression upon the selected farming communities which are to set an example to the scattered farmers throughout the Union and thus render comparatively easy the further work of the organizing body.

CONCLUSION.

27. I have now completed my task and must hand it over to those who, if they consider my doctrine sound, have the necessary influence to get action taken upon my scheme for the improvement of agricultural conditions in South Africa. I shall not be blamed for the length or complicated character of this memorandum. If my proposal was to be of any value, it had to be explained in its relation to the existing situation and worked out in some detail. The problem discusssd cannot be a simple one, admitting of an easy solution, or it would have been solved long ago. I have said many things my agricultural readers already know; but if, as I firmly believe, all other interests depend very materially upon the well-being of the chief wealth-producing industry,* I may be forgiven for helping the townsman to understand the problems of country life. Nor need I apologize for my intrusion into the affairs of a country to which I do not belong. In the peculiar circumstances, an outside observer may have a little more than the proverbial advantage of the looker-on at the game. As an Irishman who has worked upon analogous problems in his own country, I can understand the different outlook of the two races which dominate South Africa. I trust that in this matter both will see that only by their cordial co-operation can a white nation be firmly established on the one sure foundation, a prosperous and progressive agriculture. When that union is cemented, it will matter not at all whence come the immigrants who are needed to ensure the control by the white people for the good of all.

28. If it were only to statesmen I were addressing my argument, and my appeal on behalf of the farmers, I should be pushing an open door. But the solution of the rural problem I have been discussing

* I develop this contention above in paragraphs 3 and 5.

does not depend wholly—or even mainly—on what government can do for farmers; it depends far more upon what, by organized voluntary co-operation, they can do for themselves. The strange thing in the South African agricultural situation is that, owing to one happily remediable defect, to which I have ventured to call attention, an agricultural policy, as sound in its conception as it has been bold in its execution, has largely failed of its purpose. I have suggested means by which the defect can be remedied. It is a case, if ever there was one, where we may exclaim with the poet I have quoted in another connexion:

Oh, the little more, and how much it is;
The little less, and what worlds away!

The little more is the co-operative education and organization of the primary producers. At an earlier stage in my work I hoped to see Ireland leading the English-speaking world in thought upon its rural problems. The Wembley Conference gave generous recognition to my country's contribution to the modern problem of agricultural development. I have tried to show that it is well within the power of the South African farmers to bring an enduring prosperity to their own country by completing a scheme of agricultural organization in which they have already in so many ways given a lead to the other self-governing Dominions.

Nurseries in Quarantine at the 1st September, 1925.

Name.	Address.	Cause of Quarantine.	Extent of Quarantine.
Distributors Co., Craighall Nurseries	Craighall, Johannesburg	Crown-gall and Root-gall Worm	Deciduous, all.
Sunnyside Nursery ...	Louis Trichardt...	Red Scale ...	Citrus, all.
D. J. Conradie & Bros.	Robertson, C.P. ...	Red Scale ...	Citrus, all.
A. S. Strydom & Co. ...	Krakeel River ...	Woolly Aphis ...	Deciduous, part.
Craighall Estate Nurseries	Craighall, Johannesburg	Pernicious Scale...	Deciduous, all.
G. J. Labuschagne ...	Groot Marico ...	Red Scale ...	Citrus, all.
Distributors Co., Craighall Nurseries	Craighall, Johannesburg	Pernicious Scale...	Deciduous, part.
Rand Nurseries ...	Johannesburg ...	Pernicious Scale...	Deciduous, all.

THE GASTRO-INTESTINAL WORMS OF SHEEP.

A Menace to Sheep Farming.

THE last exceptionally wet summer has brought with it a tremendous increase of worm parasites in sheep. Since the beginning of the year sheep have been dying, and are now still dying, in unusually great numbers on account of worm infection, which has spread over practically the whole country and has become an alarming menace to sheep farming, threatening ruin in many places to one of South Africa's most important farming industries. The Veterinary Research Department has foreseen this possibility a long time ago, and has repeatedly warned farmers against the dangers of overstocking and improper farm management, and has recommended methods of control which, had they been properly carried out, would have prevented this disaster. It has long been recognized that a proper system of farm management is the most important method of control against worm diseases in sheep, but, instead of accepting this advice, farmers have persisted in asking for remedies.

Formerly, the wireworm (*Haemonchus contortus*) was practically the only worm that caused damage; later the nodular-worm (*Oesophagostomum columbianum*) and the bankrot-worms (*Trichostrongylus instabilis* and *T. rugatus*) became troublesome. At present several other worms, viz., the hookworm (*Bunostomum trigonocephalum*), the thread-necked worm (*Nematodirus filicollis*), and the brown stomach-worms (*Ostertagia ostertagi* and *O. circumcincta*) are rapidly spreading from various centres. Unless control measures are at once adopted these worms will soon make sheep farming impossible, and even other species that are still of limited occurrence will be allowed to spread. It is improbable that efficient remedies against all these worms will ever be found, but a proper system of farm management can prevent the whole trouble.

SYMPTOMS OF WORM INFECTION.

Lambs under a year old suffer most from worms. They usually begin by purging and then rapidly lose condition, also showing a marked paleness of the mouth and membranes of the eye, with sometimes soft swellings under the jaw. On cutting open such an animal one finds that the body cavities and heart sac contain a large amount of clear fluid, the fat has disappeared and is replaced by a jelly-like tissue, the whole carcass is pale, and the blood is watery. On examination of the contents of the stomach and intestines the worms that have caused the condition are found; sometimes only one kind, but often several kinds being found in a sheep.

The wireworm occurs in the fourth stomach, and can be recognized by the spiral striation of the female, which gives it the appearance of a barber's pole. The worms often lie in a reddish-brown mass, which consists partly of blood derived from little wounds in the stomach made by the worms.

The nodular-worm is a white, rather stiff worm, just under an inch long, and found in the large intestine. This worm causes the formation of nodules in the intestinal wall, which are seen when the sheep is cut open. When the lamb gets infected the young worms penetrate into the wall of the intestine and a small nodule is formed which is reddish, due to presence of blood. Later pus accumulates and the nodule turns green; after about five days the worm returns to the lumen of the intestine, and the nodule may heal up or become a hard mass, which remains permanently. The nodules may be only small in number or so numerous that the wall of the large intestine is much thickened and stiff, and accordingly its function is interfered with. The nodules may further be the cause of two complications:—(1) They may become infected with bacteria which are present in the intestine and form small abscesses; the latter may break open on the outside of the intestinal wall, the contents being liberated into the body cavity, which gives rise to peritonitis and death. (2) A piece of the intestine may become telescoped or pushed into an adjoining part, shutting off the canal, which is fatal. Invariably nodules are found in such a part, and they are therefore believed to be a mechanical cause of the condition. Sheep that are so affected stretch themselves in a very characteristic manner, hence the name "reksiekte."

The bankrot-worm is found just behind the stomach in the first part of the small intestine, lying partly under the lining membrane. They are about a quarter of an inch long, light brown in colour, very fine and difficult to see. The inside of the intestine is usually thickened in this part and often reddened. When sheep, especially Persians, get a heavy infection of these worms all at once they may die in a few days without losing much in condition, and sometimes show symptoms of paralysis.

The hookworm is about an inch long, moderately thick, and pink in colour. It is found in the small intestine, usually the last half, where it is attached to the intestinal wall sucking blood and leaving little red spots where it has been biting. In addition to the usual symptoms, this worm often causes marked weakness or even paralysis.

The thread-necked worm is about an inch long, pink in colour, and found in the small intestine, where it usually lies with its thin neck curled up in a little bundle.

The brown stomach-worm is found in the fourth stomach, like the wireworm. It is smaller than the latter and more dark-brown in colour. It also produces small wounds and often little white nodules, the size of a pin's head, on the lining of the fourth stomach.

LIFE-HISTORY.

All the above-mentioned worms have very similar life-histories, as far as the development in the veld is concerned, which is the important part with regard to preventive measures. The eggs are passed out with the droppings of infected sheep, and under suitable conditions they hatch and the young worms develop in the pasture for three to six days, until they are able to infect sheep which swallow them. The conditions necessary for development are important to note. Moisture is the chief essential, and warm weather is more favourable than cold. In summer, when it rains, practically every

egg will develop, while in winter development proceeds very slowly on account of the cold, and the eggs soon dry up and die. This explains why a very wet summer provides the most favourable conditions for the multiplication and spread of worms. When the young worms have reached the infective stage they are very resistent and can live at least a year. In order to be swallowed by grazing sheep, the young worms crawl up blades of grass and bushes when these are moist and the sunlight is not too strong, i.e. when it rains, or in cloudy weather, or at night and in the morning when there is dew on the grass. At other times they descend to seek shelter in the soil, and here they can also be found during the winter, although the majority die in winter. Sheep grazing at such times, when the worms are on the grass, will swallow the parasites with the grass; this goes to the paunch or first stomach, and from there the young worms then find their way into the fourth stomach or the intestines.

The hookworm is the only one that differs from the above. The young worms in this case develop only in marshy places or vleis, and they do not crawl on to the grass, but remain in the water. It is not known how sheep get infected in this case, but it is possible that these worms, like the human hook-worm, penetrate through the skin and first get into the blood, reaching the intestine in a roundabout way.

TREATMENT.

The Laboratory Wireworm Remedy has been used against the wireworm with great success, and this is the only one of these worms against which an effective remedy has been found. For all the other worms and the conditions caused by them there are no suitable remedies. Curing nodules and "reksiekte" with drugs is out of the question. The nodular-worms, being situated in the large intestine, cannot be reached by drugs given by the mouth, as they would all be absorbed in the small intestine and would not reach the worms. In the case of the hookworm, carbon tetrachloride gives good results, but the drug is expensive and difficult to administer. In all the other cases the drugs tried have failed. We have therefore to rely on measures which will prevent the sheep from getting infected.

PREVENTIVE MEASURES.

These are based on the life-histories of the worms concerned. From the above description of the life-histories it is clear that sheep get infected in summer when the pasture is moist, and that this is the time when preventive measures should be taken. During autumn and winter, when sheep die of the infection, it is too late and very little can be done. The preventive measures advised are the following:—

1. Dose the sheep every three to four weeks regularly with Laboratory Wireworm Remedy from the time that the veld becomes green in spring until it gets dry in autumn. This has been advised for a long time, and yet few farmers have carried the dosing out regularly. Many wait till the sheep show signs of infection, but that is too late. The sheep must be cleaned of wireworms before the rains begin, so that they cannot infect their pasture: and after that regular dosing will keep away wireworms and give the sheep more strength to resist other worms, some of which will be killed at the same time.

Where this has been done, worm trouble has never been as bad as on other farms.

2. Seeing that lambs suffer most, lambing should be arranged to take place in winter, so that the lambs arrive at a time when there is the least danger of getting infected. During the next summer they must be kept on a clean pasture away from other sheep so that they will be safe. This can be done as follows:—

> Two camps, A and B, are made for lambs, preferably on high parts of the farm, while the older sheep are kept on the rest of the farm, which we may call C. Camp A should have been kept free of cattle and sheep for a year. Now, the first winter the ewes and lambs are placed in A, while B is left free. The ewes, although they may have worms, cannot infect camp A during the winter, as the eggs they drop will die, but they must be removed to C before the summer rains begin. The lambs remain in A until they are a year old, i.e. the next winter, when they are brought to C. The following summer, when they have to graze on infected pasture, they are 18 months old and over the most dangerous period. The second winter camp B is used in the same way as A was the previous year, while A is again left free for a year, and so on. While a camp is left free no goats or cattle should be allowed in it as they would infect it; the nodular-worm in sheep, however, does not occur in cattle.

This rotation method is one of the most important measures in worm control, but it cannot be carried out on an overstocked farm. Overstocking, on the other hand, is one of the greatest factors in the propagation of parasites, and farmers are warned against the dangers of overstocking, which makes rotation methods impossible and is responsible for increase of parasites, deterioration of the pasture, and can ultimately lead to total ruin of a farm.

3. Vleis, pans, and drinking-pools are dangerous places. In and around them where it is moist worm-eggs can always develop, even in winter. They should be drained or fenced off wherever possible, and especially in the lamb camps above described there should be no such places accessible to the sheep, else the ewes will infect the lambs in winter and the whole arrangement will be useless. Watering should be done from raised troughs.

With the above measures carefully carried out, the worm trouble can be overcome to a very large extent so that it will practically disappear. Two other measures which are still under investigation are advised for a trial:—

4. A tobacco lick is supposed to kill young worms as they enter the stomach with the grass before they reach the intestine. Any waste tobacco can be used as long as it contains sufficient nicotine. It is coarsely cut and moistened, giving 5 volumes of tobacco and 1 volume of salt, well mixed, and using about 1 lb. tobacco for 100 sheep daily. The lick should be placed in troughs where the sheep can have access to it in the morning before going to graze, and should be given daily from the beginning of the rainy season until the veld is dry in winter. It is intended to be a preventive measure only and will not kill adult worms in sheep, and is therefore only of use during summer, when the sheep can get infected.

5. An enema, i.e. an injection through the anus, gives promising results in killing adult nodular-worm in sheep. It is not applicable to a large flock, but could be used for the worst cases. The hindquarters of the sheep are held up and about 6 inches of a piece of rubber-tubing is gently pushed into the bowel through the anus. At the other end of the tubing a funnel is attached, and through this one pours about a pint of warm soapy-water, which will clear the bowel, when the sheep is released. The same procedure is repeated, now giving a pint of water containing a small quantity of thymol or other worm remedy, e.g. carbon bisulphide or petrol, using in each case a small (level) teaspoonful to a bottle of water.

When a sheep improves in condition it usually overcomes its worm infection. Heavily infected sheep should therefore be separated from the flock and given nourishing food, and a tonic lick of iron sulphate (1 part), bonemeal (3 parts), salt (3 parts). *(Division of Veterinary Education and Research.)*

Agricultural Education: A Recent Publication.

Recent years have shown a marked expansion in the organization of the Department of Agriculture, the aim being particularly to advance the education of the present-day farmer. But perhaps the movement that is fraught with the greatest future benefit for South Africa is that concerning the teaching of agriculture in primary and secondary schools now being widely discussed. Teachers throughout the Union are taking a keen interest in the matter, and this Department receives many applications for literature on agricultural subjects suitable for school instruction. In this respect mention may be made of a book, timely in its appearance, that has recently been published. It is entitled "Landbouonderwys deur die Skool," and obtainable from Die Volksblad Boekhandel, Bloemfontein. It was written by Dr. Geldenhuys, Chief of the Division of Economics and Markets, before he joined the Department. The author, alive to the importance of a wise system of education in a country whose destiny rests largely in the hands of her farmers, gives a comprehensive survey of the birth and development of agricultural education in South Africa and also in the United States. Helpful, constructive advice, gleaned from many authoritative sources, is given as to the methods to be pursued in the education of the youth of our country so as to produce a body of farmers well equipped for their calling in life. Dr. Geldenhuys's book comes at an opportune time. It should be read by all concerned in the teaching of agriculture, whether at the faculties of agriculture, the agricultural schools, or in the primary and secondary schools of the Union.

THE GREAT DROUGHT PROBLEM OF SOUTH AFRICA.

IV.

Gaining a New Province.

THE previous chapter portrayed the disastrous effects of the present system of stock-farming and the consequent need for improved methods. The Commission has gone further, and estimates the value in sterling of the beneficial economic results that would follow a general application of its recommendations. South Africa, in so far as most of its territory is concerned, is likely always to remain a sheep country, and therefore it is essential that, on this basic understanding, all effort should be directed towards improvement of its most important industry. At the present time the economics of sheep-farming turn about the question: "How many sheep can be carried per morgen?" Soon the question will be: "How many pounds of wool are produced from one morgen annually?" The answer to the latter will reveal not only the capacity of the farm and the quality of the sheep, but also the ability of the farmer. The wool production of the Union should be much greater. While the area available for grazing is limited its carrying capacity can be increased; moreover, an improvement of breed will enhance the average yield of wool per sheep.

A great deal of evidence was collected by the Commission as to the effect on the small stock of the country that would result from the introduction of the paddocking system in place of that now prevailing and the improvement generally that would follow. This evidence was carefully sifted, weighed, and averaged, and from it a conservative estimate was made of the increase that could be expected in the number of woolled sheep, and that, moreover, without giving over any additional farms, or portions of farms, to the industry.

The following is a summary of the estimate, viz.:—

Area.	Present Number.	Estimated Increase.	Estimated Total Number.
Cape Province	11,258,347	6,250,805	17,509,152
Natal	1,208,262	472,388	1,680,650
Transvaal	2,848,405	1,446,471	4,294,876
Orange Free State	7,608,834	4,205,719	11,814,553
Total for the Union	22,923,848	12,375,383	35,299,231

This shows that if all the areas at present given over to sheep-farming were properly paddocked, they would be able to carry 54 per cent. more woolled sheep; in other words, where to-day 100 sheep can be run the increased capacity would permit 154 sheep to be run. The gain to the country would, as a result, be enormous. It is agreed that a sheep running free (as provided for in the paddock system) is so much healthier and grows so much better that it produces more wool. Not only does it produce more wool, but it produces better wool, which, moreover, is cleaner, because the sheep would not be kraaled. Taking all these advantages into account, it is found that paddocking will more than double the money annually received for wool in the Union. At an average price of 1s. per pound this would represent an increased annual income of £9,384,000.

Nor does this great addition to the wealth of the country end there. There would be further accretions in the form of increased mutton production and sheep and goat skins, so that altogether the Commission estimates that the financial improvement in small-stock farming resulting from the adoption of paddocking would be as follows:—

Increased value of wool	£9,384,000
,, ,, sheepskins	881,321
,, ,, mutton	2,520,000
,, ,, goatskins	313,880
TOTAL	£13,099,201

On a conservative basis of 10 per cent., this extra income would have a capitalized value of say £131,000,000. Comparing this with the total valuation of the Cape Province (in 1918), it would be equivalent to a new province being added to South Africa equal in value to 84 per cent. of the Cape Province.

Not even at this vast sum would the benefits cease, for additional gains would follow in the form of considerable savings. Scab and diseases generally would decrease and the money now spent in fighting them be saved. The toll paid directly to the jackal and droughts, and the cost of an army of shepherds, would be greatly reduced. The number of Europeans supported directly and indirectly by the small-stock areas would increase, and, as a result, the cost per capita for education, railways, and administration generally would decrease. Soil erosion would become less. All these savings are definite enough, but difficult to estimate. It is clear, however, that the gain to the whole community by reason of the system of paddocking would be so great that in itself it should be sufficient incentive to ensure its speedy adoption, let alone the danger facing the country that urgently calls for it.

THE SUCCESSFUL ADOPTION OF PADDOCKING.

The steps to this most desirable end are pointed out by the Commission. The successful adoption of the paddock system depends on cheap fencing, a supply of water in each paddock, control

of the jackal, and prevention of stock thefts. Dams should more generally be constructed where possible, instead of only sinking boreholes and wells as is now the tendency. Even small dams are a valuable asset provided the paddocks containing them are grazed before the water has percolated or evaporated. Paddocks containing larger reservoirs, or permanent supplies, should be reserved until the water-supply in the others has given in. But it is urged that in any event stock should not be allowed access to the dams nor to springs; instead, the water should be led in pipes to suitable drinking troughs. Not only does such an arrangement make for healthy stock, but it also economizes the water-supply. Boring has proved a big boon to South Africa in rendering large areas capable of being grazed which, without boring, would not have been able to carry any stock. But being easy and cheap, boring has not proved an unmixed blessing, for it has led to the presence of many drinking places and so to overstocking. It has also replaced the more expensive dam building, which means that by boring the ground-water is continually being tapped, and the dams which would tend to strengthen this ground-water are absent. It is recognized that in some parts it is quite impossible to construct dams, and boreholes are therefore necessary. Settlers, in these newer districts where losses in time of drought are caused by thirst and not by starvation, are warned against the danger of overstocking their farms which might be induced by the presence of too many boreholes.

There is another source of supplementing the ordinary water-supply of the farm (quite apart from food consideration). It is the drought-resisting succulent plants such as the prickly pear and the American aloe (*Agave*). The repeated advice of the Department of Agriculture as to the value particularly of the prickly pear should be known to all farmers: experiments show that sheep can be kept in perfect health for nearly two years with no other source of water than that provided by this plant.

Australian experience emphasizes the vital importance of an adequate water-supply for stock. It is well known that droughts in that country are of greater severity than ours, and the sheep-farmer there has learned, doubtless through the mill of bitter experience, what farmers in South Africa have not yet apparently fully realized, namely, that water alone is capable of keeping sheep alive for many days, provided they are properly handled, whereas food with inadequate water is not.

THE SHADOW OF THE JACKAL.

When probing the causes of the unhappy consequences that are retarding the country so seriously, the sinister figure of the jackal is found to loom at the back of it all. It throws a shadow that lengthens with time. To it can be traced the beginning of the evil. And if the processes that the jackal has set in motion are to be stayed one of the first steps is the removal of the pest. It is a problem that has exercised the farmer for a hundred years, and notwithstanding all his ingenuity and resource in combating it, the jackal remains an unconquered enemy. But the jackal must be brought under control and, if possible, exterminated. Little permanent success will attend the efforts to destroy it in any district unless it be first pinned down to an area which will permit of its

being eradicated rather than driven away, and the Commission considers that nothing is more calculated to lead to this end than jackal-proof fencing. The Fencing Act of 1922 provides facilities for this purpose, and every farmer should be acquainted with the provisions thereof.

The State is alive to its obligations in regard to the eradication of the jackal in outlying areas. It has also made provision for dealing with stock thefts. It is aware of the need of an efficient control of insect and other pests that may be the cause of seriously lowering the stock-carrying capacity of the farm. It is giving attention to the prevention of the spread and the eradication of growths known to be useless for fodder purposes (even where animals are starving) and detrimental to the grazing yield of the veld.

THE FARMER'S RESPONSIBILITY.

These are all matters of serious import that are engaging the attention of the Government. Yet, important as they are, their successful issue is dependent upon the individual effort of the farmer. It is upon him that the first responsibility rests in adopting better farming methods. Could such be generally put into practice, deterioration would be stayed, and the well-known recuperative power of the South African veld would receive a permanent stimulus that in a comparatively short period of time would bring an era of prosperity.

Many farmers indeed are so alive to the danger of overstocking and to the need for improved methods that they advocate that legislation should be passed preventing too large a number of stock being put on a farm. Others go even further and suggest that farmers should be forced to rest portions of their farms in rotation. If such legal enactments could be enforced, the drastic procedure would unquestionably be justified, but there are difficulties that render it impossible. For instance, a fixed ratio of area to number of sheep could not be laid down for the whole Union, not even for a single district; each farm and farmer would have to be gauged individually. No, the matter rests primarily with the farmer himself, and the press of circumstance, if nothing else, will in time force him to adopt up-to-date methods.

And here the pertinent question arises as to whether the precarious system of farming at present practised is compatible with the keeping of really good stock. Only after the farmer has taken the necessary precautions against drought losses, dare he consider the purchase of first-class stock, for without such precautions the risk would be too great. Thus soil erosion, veld deterioration, lack of foresight in providing for droughts and resulting stock losses, act against improvement of breed.

As an additional factor in the present evil, mention is made of the extensive areas in possession of land companies and absentee landlords, which appear to be mainly occupied by native tenants. The communal system of farming, as carried on by the native, is fundamentally bad, but this leasing system appears to be even worse, and adds its share to the maltreatment of the veld that is now going on.

COLD STORES AND STABILITY.

In urgently pressing the farmer to adopt methods that will lead to greater production, the Commission throughout has been mindful of the measures that should be taken by other sections of the community to make the farmer's efforts economically possible and in this respect has taken into account the important matter of cold storage facilities. In an earlier chapter the need of seasonal forecasts was mentioned as a means whereby the stock-farmer would be warned, when the time arose, to remove at an early date unnecessary "eaters" from the veld and thus leave more fodder for the remainder. Similarly the establishment of a large number of cold storage depots would favourably affect the position. Conditions to-day are such that at the end of a good season a farmer has a considerable number of fat stock for disposal; but unfortunately, owing to a limited demand, the markets become glutted and prices fall. This leads those who can do so to hold over their stock which loses weight throughout the winter, and such surplus stock consumes fodder and water which should have served for the other animals. And the greater portion of the slaughter stock of the Union comes forward as a general rule at the beginning of winter, so that although the demand for mutton is fairly constant the supply of fat stock is not. Were the farmer assured a uniform price throughout the year, he would be able to direct his farming operations with an eye only to the fatness of his sheep and the state of his veld. If cold storage were available, he would dispose of his stock at the beginning of the winter, and thus the weight the animal now loses in winter (representing an enormous waste of flesh every year) would be conserved, and the veld it now consumes in winter be saved. This would tend to reduce the fluctuation in the price of slaughter stock—an advantage to all concerned—and obviate the deplorable necessity of South Africa importing mutton.

An examination of figures obtained at the Bloemfontein Municipal Abattoirs shows (over a four-year period) that in summer or early autumn when the stock is in good condition, the butcher has no need to pick and choose. During that period, therefore, the stock slaughtered is typical of the average animal on the veld. But in late autumn and winter, only the best obtainable are fit for slaughtering, and the abattoir weights are far in excess of the average on the farm. While an estimate of the losses in flesh occasioned by the lack of sufficient cold stores is not attempted, the Commission is definite that if cold storage were distributed throughout the Union it would lead to an increase in the productivity of the country in the supply of prime meat, stabilize the market, and materially reduce drought losses and the deterioration of the veld, including soil erosion.

As to the saleability of the frozen meat, it is pointed out that all the meat stored need not necessarily be frozen, but a considerable portion intended for early consumption need only be chilled. As for the frozen portion, it could replace the article now imported, and for which, apparently, there is a considerable market in the Union.

The Commission endeavoured to ascertain cold storage costs, but its attempts were not very successful. Cold storage, such as that proposed, has not been practised in the Union to any great extent, and the charges quoted evidently did not reflect the actual cost,

seeing that with equal facilities for obtaining coal, the charges vary nearly 100 per cent.

Then also a more general making of biltong and the production of meat extract are suggested as a means of reducing the number of grazers during the winter and so lead to a more economic use of the veld.

Thus, better farming and closer organization among farmers (with all it will command) will greatly enrich South Africa and bring to those who have deservedly earned it the full reward for their labours. It is an ideal that the younger farmers particularly should unceasingly pursue. Its attainment is within reach of all.

(NOTE.—For further particulars respecting the matters referred to above, see Chapters XIX, XX, XXI, and XXII of the Drought Commission's Report.)

V.

The Scope and Practice of Irrigation.

THERE are two common beliefs in South Africa that have no foundation: one is that our drought losses are due to a diminished rainfall, and the other that irrigation is capable of turning the whole of the Union into a flourishing garden and so overcoming drought. It has been shown that there is no evidence to support the first, while the extent to which irrigation development is possible in South Africa is definitely limited by rainfall and run-off (which represents only 6½ per cent. of the total rainfall), in addition to other minor factors. Yet, if the run-off from the entire Union, including Basutoland, could be saved and made available, it is estimated that only a little over six million acres of land could be irrigated. Moreover, one-half of this run-off is derived from the coastal fringe of the country, and the coastal rivers flow through extensive areas where irrigation is either unnecessary or plays only a very small part in the agriculture of that area, while in many parts elsewhere where irrigation is needed the high cost of the necessary works or the unsuitability of the soil makes it economically impossible. Thus the above estimate can never be approached in practice, and even if reduced to three million acres (or 1 per cent. of the Union) would still be considered optimistic. And so the roseate dreams of extensive irrigation areas in South Africa can only remain dreams. As pointed out in a previous chapter, the great mass of the country's rainfall can only be used by the individual farmer when it falls, and it is his duty to make the best of it and prevent excessive evaporation and other causes that rob him of so much of it. But, nevertheless, though the irrigable area be limited and the available run-off from the rainfall comparatively small, irrigation remains a highly important factor in the development of our country.

THE SOURCE OF THE UNION'S IRRIGATION WATERS.

Of the three million acres estimated above, a little less than one-half lies in the Orange-Vaal catchment, which embraces the basins of the Orange and Vaal Rivers and all their tributaries. This catchment is the most important in South Africa from an irrigation point of view. It is followed in importance by the Limpopo basin with an irrigable area about half that of the other. Indeed, investigation shows that one-third of the total water usable for irrigation is derived from these two catchments, which cover only one-twelfth of the Union's area.

There is, however, a considerable difference between the total run-off and the useful run-off or volume which may eventually be usefully employed in irrigation. For instance, irrigation may be unnecessary or impossible in some places, or the run-off may be so extremely variable and uncertain as to be only partially usable economically. Thus the true value of a catchment for water supply purposes depends upon its usable or useful yield; not on its total yield or run-off.

GROUPING OF RIVER CATCHMENTS.

The accompanying map represents the groups of river basins into which the Union has been divided. By a series of charts and maps the Commission shows how one-third of the total useful run-off and potentially usable for irrigation in the Union comes from the Quathlamba-Drakensberg group (comprising roughly the Klip, Wilge, and Upper Vaal Rivers, the Caledon and the Upper Orange Rivers). Further, this group, together with the Orange-Vaal basin below it, which comprises the Central group shown on the map, gives one-half of all the usable water of the Union. Commanded

by the yield of these two groups lies 41 per cent. of all the land in our country that is actually or potentially irrigable. And the Commission points out that the value of this most important area as a catchment for irrigation water is deteriorating, and sounds a note of warning.

THE DETERIORATION OF CATCHMENT AREAS.

Destruction of vegetation, formation of tracks, and grass-burning—all tending to greater speed of run-off—are ruining the country. Dongas are being formed, and rain that formerly caused streams to commence running days after it fell now fills the water-courses within a few hours of its fall. Where the stream beds were formerly covered with a few inches of clear limpid water running for weeks, they are now scoured by torrents of muddy water running for hours only. Where water from these streams could formerly be diverted by simple structures and utilized for irrigation, extensive costly weirs and protective works are now necessary. Where the water was formerly available at any time during the summer, it can now be used for irrigation only at rare intervals; and as with the smaller streams and tributaries, so also with the larger tributaries and rivers.

Similar deterioration of catchments has taken place in many parts of the Union. The Nuy Irrigation Board, Worcester, has indeed gone so far as to purchase 10,200 morgen of mountain area within the catchment of their water supply merely to be able to control it to prevent veld fires and general destruction of vegetation. And just as it was necessary in this instance, just so necessary is it in other areas to take similar action, and particularly is it needed to preserve that nationally important area, the Quathlamba-Drakensberg and Central catchments, for we are allowing an invaluable asset of the country to be frittered away.

The Union will always remain essentially a stock-raising country. As the population of the world increases, more land generally will be needed for crop-raising, so that the ranching areas of South Africa will assume greater and greater importance in the trade of the world. Only by the full development of irrigation possibilities can the full capacity of the country for stock-raising be attained. It is the bounden duty of the present generation to guarantee for the days to come the possibility to irrigate. Therefore the need is not to accelerate irrigation development (for much has already been done and steady progress is to be expected in that direction), but to preserve our catchments, a national work that must not be delayed; for delay in dealing with the matter not only means stagnation, but actual retrogression.

IRRIGATION PROBLEMS TO BE FACED.

Irrigation is already being used to a considerable extent as an adjunct to stock farming for the purpose of supplying fodder to lambing ewes, for fattening purposes, for insurance against drought losses, for dairying purposes, and so on. In parts also where the natural rainfall does not render it unnecessary, irrigation will probably always be employed in the raising of fruit, vegetables, etc. But no matter for what purpose irrigation is used, there are certain

problems that are common to every farmer who irrigates his land. And most have yet to acquire the art of the practice.

As a general rule irrigation schemes in South Africa have in the past been designed to obtain water from storage reservoirs built in water-courses (which usually carry water immediately after a rain only), or as flood schemes to utilize as much as possible of the water of Karroo rivers during the short and infrequent periods of their flow. The tendency of late years, however, has been in the direction of constructing large reservoirs in the beds of intermittent rivers for the purpose of storage and for regulating the flow.

The stock farmer with a few morgen under irrigation has in a good year returns from both stock and irrigation, while in a year of inadequate water he still has returns from his stock to fall back upon. But under the larger schemes the tendency will be for irrigation to be practised as the sole business of the small farmer, and a failure for one year will ruin many, if not most, of the irrigators. The flood scheme is therefore useless for the purpose of closer settlement. Besides, in such schemes a large part of the growing season in the greater portion of semi-arid South Africa is past before water is available, as the rains are plentiful only towards the end of summer; thus several possible cuttings of lucerne are lost, while early frosts play havoc with the backward crops. To insure against this, large storage reservoirs have been built, either to supply water during a dry year or, where the rivers concerned have a fairly certain annual flow, to guarantee a supply of water in the spring and early summer.

THE GREAT TASK OF WATER STORAGE.

A serious feature that becomes increasingly evident with the passing of the years is the succession of floods caused by the accelerating speed of run-off, due to soil erosion, etc., each succeeding flood being yet another symptom of man's wrongdoing, adding yet further proof of the manner in which he is ruining our country. These floods increase the cost of the irrigation works and the amount of artificial equalizing storage that must be built to regulate the flow of the rivers to guarantee water to the irrigator. How much better is not Nature's regulator in the form of vegetation, which breaks the speed of the run-off and lets down the water gradually into the water-courses?

The probable life of the reservoir is of vital importance to the irrigator in South Africa, and its useful life is usually limited merely by the period of effective storage. A reservoir collecting clear water or a water whose suspended solids do not readily precipitate will have a long life: where opposite conditions prevail, the life of the reservoir is shortened. Here, again, in our land of characteristically muddy rivers, are we confronted by the ever-present evils of veld deterioration and soil erosion. Water passing over grassy slopes or well covered veld is clear, or contains very little of suspended solids, but water coming over veld that is bare or cut up by dongas not only carries in suspension much easily precipitated silt, but also rolls along the bottom of the dongas a very considerable amount of large, heavy particles, none of which can be transported past the reservoir. And so the whole question of storage is wrapped

up with the question of silting, which shortens the efficient life of the reservoir.

SILT THE LIMITING FACTOR.

It is not necessary that the reservoir should have silted up to over-flow level before it fails to function efficiently. The process of deficiency operates at a much earlier stage of silting when the growing insufficiency of the water supply correspondingly levies its toll on the extent of the irrigable area originally contemplated. This general detrimental action of silt on the storage capacity of reservoirs is well known, and the necessity for studying the silt aspect of our rivers is obvious.

There are several instances which serve to indicate the relative silt contents of different rivers. In certain localities it is found that wire-netting stretched across a sloot will hold up débris first and finally enough silt to fill the sloot. In others, well packed walls of unwrought stone have failed in a decade to collect a teaspoonful of silt from a stream of muddy water. Some reservoirs silt up rapidly, others not. Again, reservoirs which hold up only a small proportion of the water which passes through them, such as, for example, those formed by weirs across rivers, collect deposits from more water than they store, and have therefore short lives, while, other things being equal, reservoirs which seldom overflow have relatively longer lives.

The question of silt is a difficult one. To all intents and purposes the prevention of silting has proved to be beyond the powers of the engineer; the evil done, that is, the contamination of the water, takes place in areas outside his control. Only by systematic and combined action over a whole catchment can alleviation be obtained, and it devolves upon the State to take the necessary steps to protect the fountain head of irrigation water supply.

Thus is shown another direction in which the present system of stock farming sends out its ill results in ever widening circles. Again it is man as the root of the evil. Whatever action the State may take, it is the individual farmer who must awaken to his responsibility, and by adopting better methods of farming help to suppress the evil that he has created.

THE ART OF IRRIGATION.

It has been the experience of the world that the area that any one farmer can efficiently cultivate under irrigation is strictly limited unless he has a very large amount of capital at his disposal. The inquiries of the Commission show also that the satisfied owner of land under an irrigation scheme is generally the one with a comparatively small holding, while he who complained was the owner of hundreds of morgen of which he could cultivate only a portion. Obviously the rate he had to pay on the large uncultivated area swamped the profit derived from the other. Herein lies one of the first secrets of successful irrigation practice.

In addition, there is to be learnt the correct and economic use of water. In flood irrigation the main essential is to prepare the lands and the distributary canals in such a manner that the largest area may be irrigated in the shortest time and with the least expenditure of labour. The surface of the lands must, of course, be graded;

otherwise uniform wetting is impossible and the proposition cannot but be uneconomic. Where, however, storage is provided and a definite amount of water is assured, the problem of the economic use of water assumes an entirely different complexion, and lies in ascertaining the amount of water needed to produce the maximum crop from a definite area. With moderate applications, each slight increase of water produces very nearly a proportional increase in the crop, but when the waterings approach the amount for maximum effect a considerable increase of water produces only a slight increase in the crop yield. It seems wise, therefore, not to go up to this limit, because the extra water required to reach that point invariably costs more than the corresponding increased production is worth. To go beyond that point is folly.

THE DUTY OF WATER.

Under our conditions the unit should be water, not land, and the goal should be to obtain the highest yield from the unit of available water rather than from the unit of land. The maximum yield depends not only on the volume of water applied, but also on the time of application and the number of applications. At certain stages of growth crops need water more than at others, so application at the correct times will lead to increased returns. As far as possible advantage should also be taken of any shade which the crop may throw to reduce needless evaporation losses.

The "duty of water" must be realized. This means the effectiveness of a given volume of water in crop production, and thus one speaks of a "high" or a "low" duty as the case may be. The duty of water is not a fixed quantity: its effectiveness depends on many factors, the most important of which are the skill of the irrigator, the nature of the soil, the kind of water, climatic conditions, and the crop to be raised.

Actual loss of water occurs in two principal ways, namely, by percolation to the water table or by evaporation from the soil surface. Such loss can be prevented in a measure. For instance, there is excessive loss by percolation when a porous soil is irrigated too slowly. If irrigated rapidly a considerable amount of air is imprisoned in the pore spaces of such soil, which prevents the water from sinking in too rapidly or too deeply, and if the drainage be poor, the ground-water level will surely rise until near the surface. In the process the roots of perennial crops will be drowned, the crop killed or rendered unthrifty, and soluble salts that were formerly distributed throughout the soil will be brought to the surface by the evaporating waters, to the detriment of the crops. If, however, the same method be applied to a fine-grained soil, the pore spaces of which are so fine as to render even air movement slow and difficult, practically all the air is imprisoned and the water sinks in so slowly that, when eventually turned off, its depth of penetration has been very short of what is required to give a high duty; and if the crop grows its root system will be shallow and unable to draw nutriment from the deeper levels of the soil. Moreover, the surface inches of the soil will usually have become so filled with water as to exclude a sufficiency of air for the needs of the plants. A soil of this type thus watered remains wet at the surface for a long time, which leads to

great loss by evaporation and the accumulation at the surface of injurious soluble salts.

DIFFERENT TREATMENT FOR DIFFERENT SOILS.

These two types of soil, therefore, require differing treatments, yet it is found in local irrigation practice that extreme types of soil, as well as those classes between them, are all irrigated by precisely the same method. Any method for irrigating fine-grained soils should (*a*) ensure good penetration of the water and (*b*) obviate as far as possible the lodging of water near the surface. This cannot be achieved unless an easy escape of some of the soil air is provided. Farmers very often have a number of furrows, a few feet apart, down which the water is slowly run. The soil surface between the furrows, not being wetted by water, provides a path of exit for the soil air, and serves also as a mulch protecting the water that has percolated from the furrows, and in this way reduces evaporation losses. Perhaps best of all is to have the land underdrained, as this induces not only good penetration, but efficient aeration.

Many irrigators do not choose their crops to the best advantage, but frequently use valuable irrigated lands for crops which could be raised more cheaply in other parts of the country on "dry lands." The market price of such crops is naturally regulated by the cheaper cost of production, and the irrigator suffers financially. And whether crops are produced on "dry" or irrigated lands, the same natural laws apply, for both systems deal with vegetation, soil, water, and air. The provision of a good mulch, through the cultivation of the surface soil and the destruction of weeds, will prevent useless evaporation of soil water, no matter whether it be derived from irrigation or from rainfall. Yet one finds a farmer carrying out this correct system on his "dry" lands and neglecting it on his irrigated plots. Every irrigator should put the principles of dry farming into effect in order to enable him to achieve the highest possible duty of water. Surely the same care should be taken to conserve the water that has cost much labour and capital to obtain as is given to that which drops free from the sky. Yet it seems that this is not done in South Africa, and the returns from irrigation are not as high as they should be.

THE BRAK DANGER AND DRAINAGE.

Then there is the danger of brak. History shows that in other countries much land has, as a result of irrigation, already become so brak as to be useless for the growth of ordinary crops. And though we are still a young country so far as irrigation is concerned, on all sides is seen the evidence of damage done, or threatening, through brak, the result of incorrect practice. It may be that excessive waterings have brought up the brak ground water or that the brak originally distributed throughout a considerable depth of soil has become concentrated near the surface, which frequently happens when waterings are insufficient or the irrigator takes no steps to prevent evaporation by providing a surface mulch. Poorly graded lands also lead to the rise of brak. Brak may also be concentrated in soils by the use of slightly (and in itself not injuriously) brak water: this happens if the applications are insufficient to cause drainage or when

there is no sub-soil or lateral movement of the soil water away from the site.

Drainage, in fact, is as necessary to success in irrigation as the furrows which convey the water to the lands. Therefore the irrigator should be able to obtain, if necessary, loans for the construction of drainage channels through adjoining properties, and all benefiting thereby should contribute to the cost. Provision for such facilities, it is understood, are being provided, and every irrigator should make himself acquainted therewith.

There are places where long depressions running parallel with a river bed are being ruined by brak, whereas on both sides of these depressions, which run through the properties of many owners, there are fertile irrigated lands. Instead, drainage canals could be cheaply constructed, and would take up the surplus brak water, draining from each farm on its way to the river. This would save the ruination of fertile soil ideally situated for irrigation.

MANURE CONSERVES WATER.

The effect of manures must also be considered. Farmers do not realize sufficiently that the amount of water required to produce a crop is greatly affected by the plant-food substances available. Other factors being normal, maximum crop yields can be obtained only if a sufficiency of every one of the various plant-food substances is present in available form, and provided the relative quantities in which they are present are satisfactory. From this it follows that a crop cannot make the best use of the water supply available to it unless its food supply is in every way satisfactory.

Experiments in America with maize show that when poor soil was manured it required 56 per cent. less water to produce a given crop yield than when unmanured. Manuring soil to ensure an adequate water supply for the crop is therefore a potent means of economizing water supply.

In commenting on the question of soils when irrigation schemes are being considered, the Commission considers it more than likely that a favourable physical constitution of the soil is of much greater importance than its chemical composition: it is not practical to correct an unfavourable physical make-up, whereas chemical shortcomings can be made good. But there are cases where the physical make-up remains favourable so long as the soil gets proper treatment. The question arises: "Does the irrigator till, irrigate, and crop his land in such a way as to maintain its original structure unimpaired?" Unfortunately there are numerous instances where land formerly friable and easy to work has become hard and difficult to till, and others again in which, after several years, irrigation has resulted in an impaired ability of water to penetrate the soil.

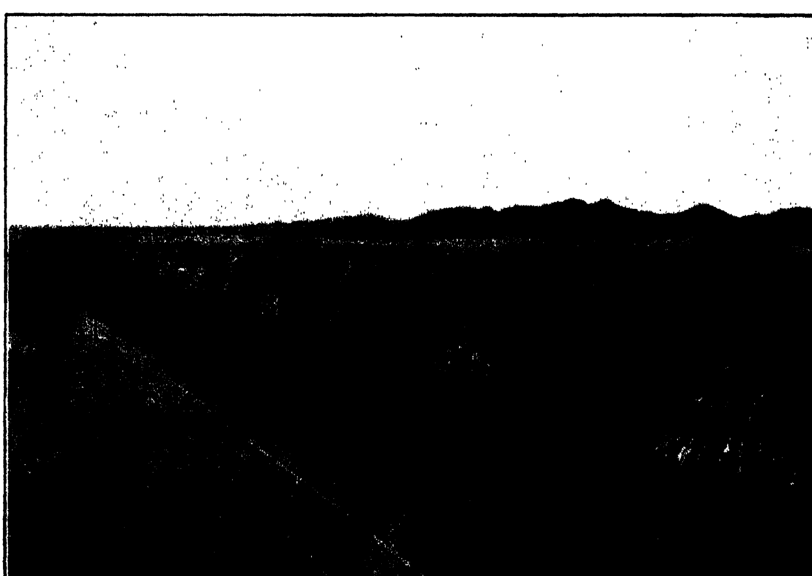
As a result of its investigations into this most important sphere of South African development, the Commission comes to the conclusion that the economic use of water is not generally realized by irrigators, who work usually too much by rule of thumb or by no rule at all. While investigations of the problems that arise in irrigation are afoot at the Grootfontein School of Agriculture, there is room for yet greater activity in this direction, not only because

of the need to make the best use of the water available, but also because the State has huge sums of money invested in irrigation undertakings. And with this matter, as with others of such vital consequence to South Africa, it is on the farmer individually and collectively that the first responsibility rests. Nor can it be otherwise in a country whose oldest, greatest, and most enduring industry depends upon the fruitfulness of the soil.

(NOTE.—For further details read Chapters XXIV, XXV, and XXVI of the Final Report of the Drought Investigation Commission.)

Two Maize Crops in One Season.

The accompanying photograph illustrates an achievement of the Hartebeestpoort Experiment Station. It shows a crop of Minnesota 133 maize one week after being harvested as stover during the first week in May, 1925. This was the second crop of the season and gave a fair average of thoroughly matured cobs.



[*Photo by J. E. Donkin.*

The Second Crop of the Season.

The first crop was sown on 11th September, 1924, and harvested during January, 1925. Seed from this crop was then sown on 2nd February, 1925, and made into stover, after the grain was well set, early in May, 1925, as shown in the photograph.

VERMIN-PROOF AND OTHER FENCING.

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VERMIN-PROOF FENCING is becoming fairly general over the greater part of the sheep-raising area of the Union, and many farmers, judging from the numerous inquiries for details and specifications for suitable types of vermin-proof fences, as well as other matters connected with fencing generally, are still doubtful or ignorant of what constitutes an effective vermin-proof fence. In view of further experience gained during the last few years, it is felt that the time is now opportune to publish, for the information and guidance of farmers, revised particulars of all matters pertaining to fencing generally.

First, it is necessary to mention that the views expressed in this article are based not only on personal experience over many years, but are supported by inquiries made of a great number of practical and intelligent farmers in areas where more experience, in this direction, has been obtained than in any other part of the country, and who, as pioneers, paid dearly for their experience during the course of their experiments. Their advice, therefore, is all the more valuable and reliable, and farmers can confidently accept the specifications enumerated herein as the irreducible minimum if success against the jackal and lynx is to be achieved.

It is also necessary to emphasize that in the erection of fencing generally, the first essentials are durability and efficiency, and to attain this, good material and workmanship are required. Farmers are, therefore, strongly advised, notwithstanding the minimum laid down in this article, not to under-estimate the cunning of the jackal, and also (with a view to longevity of the fence) to err on the side of what may be termed "wise extravagance," rather than on that of "foolish economy." It is deplorable that many farmers who erred in the latter direction are to-day still herding their sheep, notwithstanding their so-called vermin-proof fences.

It is regrettable indeed that so many flimsy and ineffective fences are being erected in some parts of the country. Many farmers, in order to get their fences high enough, resort to the undesirable and foolish expedient of planting 14-lb. standards only 15 to 18 inches deep, and sometimes as far as 20 yards apart, resulting in a weak and rickety fence, and it is feared, with a good deal of justification, that a considerable proportion will require renovation, even before the Land Bank advances are redeemed. The extra height can be obtained very profitably by the "flexible top" described below and illustrated in figure 5. Poles or standards should not be planted less than 22 inches in soft ground.

It has been proved conclusively that occasionally a jackal will squeeze through between barbed wires 3½ inches apart, and even between 3 inches of 6-inch barb if the wires are not well strained and

closely laced; and as for climbing over or creeping under, no fence can be considered really jackal or lynx proof without the veranda (or its substitute, the flexible top) and proper stone-packing at the bottom.

VERANDA SUBSTITUTE.

It may be mentioned that the veranda recommended is only likely to be erected when the neighbouring owner has not yet vermin-proofed his whole property; if he is doing so, then the boundary between the two properties becomes in effect an inner fence; in such event, if one owner only desired to erect a veranda, he would, of course, be alone liable for the cost. On the other hand, if both desire the veranda, it would not be worth while to erect a double veranda, for then they would both have to pay their own costs; it is far better, easier, and cheaper, and as effective, to construct what is known as the "flexible top," which now entirely supersedes the veranda (see fig. 5), namely, two or three barbed wires $3\frac{1}{2}$ or 4 inches apart above the main fence, strained in the ordinary way every 400 or 450 yards, and fastened neither to poles nor droppers (except where going over a rise), but just laced on to the main fence every 3 feet with No. 9 or 10 wire. If straining-posts are not long enough to allow of two or three wires above the main fence, then lengthen by joining on a piece of another iron standard.

This arrangement operates equally well from either side of the fence, because if a jackal should attempt to climb over the fence, the flexible top will bend towards him and make it practically impossible for him to get over, and as soon as he releases it, the attachment springs back into its original upright position, ready if necessary to meet one from the other side. The only objection to this arrangement is that it is too rigid for some distance on either side of the straining-posts, but these are so far between that it need hardly be considered.

"RESISTSTEEL" OR HIGH-STRAIN WIRE.

As numerous requests reach the Department of Agriculture for advice as to the suitability of using $12\frac{1}{2}$ gauge and 12 by 14 oval high-strain wires and 14 gauge barbed-wire, tests have been made with these wires with very satisfactory results. These wires represent everything that is claimed for them, and, owing to their lightness and comparative cheapness, are very economical to use and, as regards weight, certainly beneficial to the fence.

It is true that when too highly strung an occasional strand may sometimes snap during cold weather, due to its hardness not permitting sufficient contraction or expansion, and that the ends are then rather difficult to join. But this little trouble may be regarded as negligible compared with the benefits; furthermore, due to the many wires and close spacing necessary in vermin-proof fencing, the combination affords ample strength.

Figure 1 shows the corner-posts and the method of straining, running, and veranda wires. Corner and straining posts should be hard, well-seasoned "sneeze" or other hard wood, or iron standards of not less than 30 lb. weight.

Wires should not be strained on corner-posts, but on the second or "straining" post, and after straining and fastening to straining-posts, the loose end marked "XX" is fastened to the corner-post

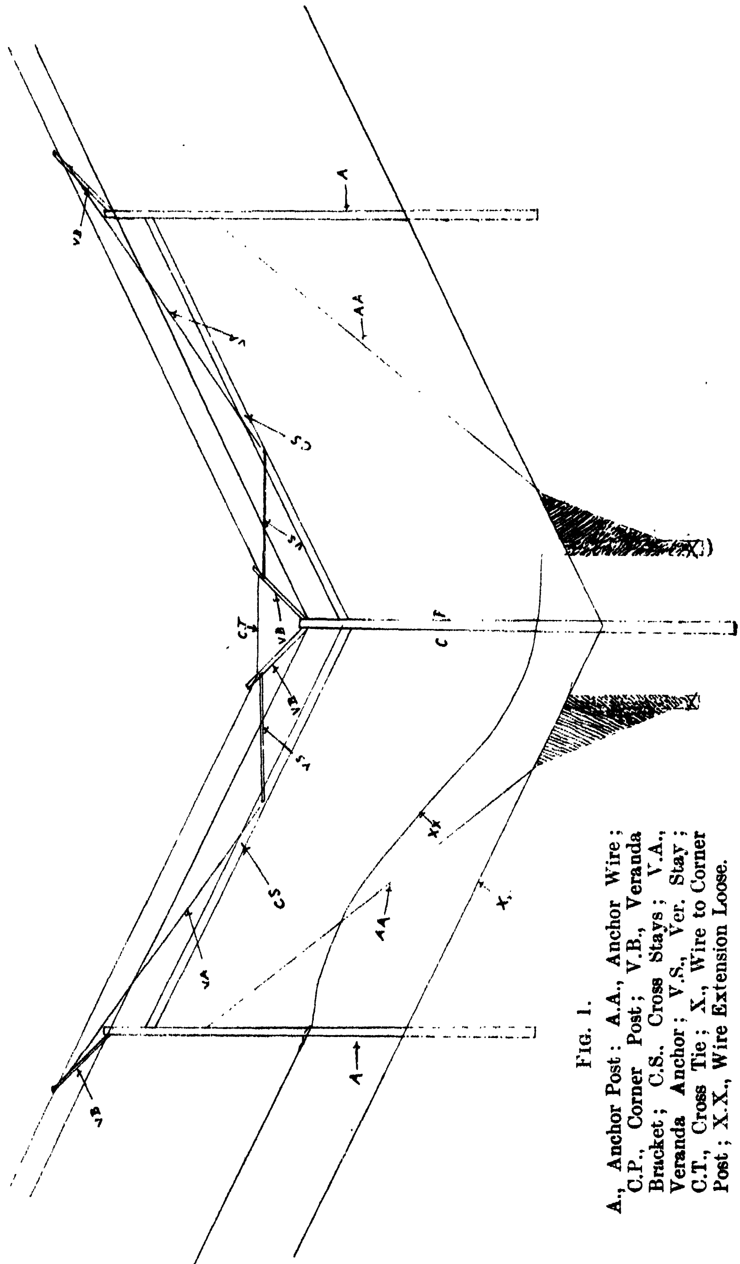


FIG. 1.

A., Anchor Post; A.A., Anchor Wire; C.P., Corner Post; V.B., Veranda Bracket; C.S., Cross Stays; V.A., Veranda Anchor; V.S., Ver. Stay; C.T., Cross Tie; X., Wire to Corner Post; X.X., Wire Extension Loose.

marked "X." In fact, the corner-posts should not be planted until all the wires are strained and all the stretch or strain taken out of the anchor wires, otherwise the corner is liable to pull out of square. Distance between corner and straining post need not be more than 6 feet. For obvious reasons the same applies to gate-posts.

MINIMUM STANDARD.

Figure 2 represents different types of vermin and sheep proof fences in sections over a distance of 15 yards (actual distance between poles), described as follows:—

(1) Straining-posts: 6-inch top hard, well-seasoned wood, or 30-lb. iron standards.

(2) Fencing-posts: 16-lb. iron standards or not less than 4-inch top hard wood.

(3) Plain wire: No. 8 ordinary or high-strain.

(4) Droppers: 2 to 2½ inch top soft wood or 1½ to 2 inch top hard wood.

(5) Barbed-wire: 12½ to 14 gauge, with barbs 3 inches apart.

(6) Netting: 3-inch mesh by 15 gauge.

(7) Tying-wire: For netting, No. 15 or 16; for droppers, No. 9 or 10; for lacing, same as for droppers.

(NOTE.—For droppers "soft wood" means pine, and "hard wood" gums or wattle. For fencing-posts hard wood means sneeze or olive.)

Section 1 in fig. 2 shows a fence with poles 15 yards apart, three plain and one barbed wire, spaced equally to support 4-foot netting, two barbed wires 3½ inches apart above the netting, with a 3-barbed-wire veranda; droppers 9 feet apart, with two laces between droppers connecting top wires and veranda, and stone-packed. The same fence could be improved very materially and the extra cost be amply justified, especially when springbuck and other game are kept as follows:—Poles, 18-lb. iron standards, 10 to 12 yards apart; droppers, 2 yards apart; barbed-wire, 12½ or 13 gauge.

The remaining sections are so clearly defined that further explanation is unnecessary, except to say that in addition to the laces a two-ply twist or double lace at each dropper and pole is all that is required to support the veranda. No rigid iron brackets are required, except where the fence goes over a rise or through a sharp dip, or as strainers, or where baboons abound.

Figure 3 is a photograph of an existing fence, taken at a straining-post, and showing a veranda of three barbed wires on the left and four on the right of the straining-post, with stone-packing on the one side only.

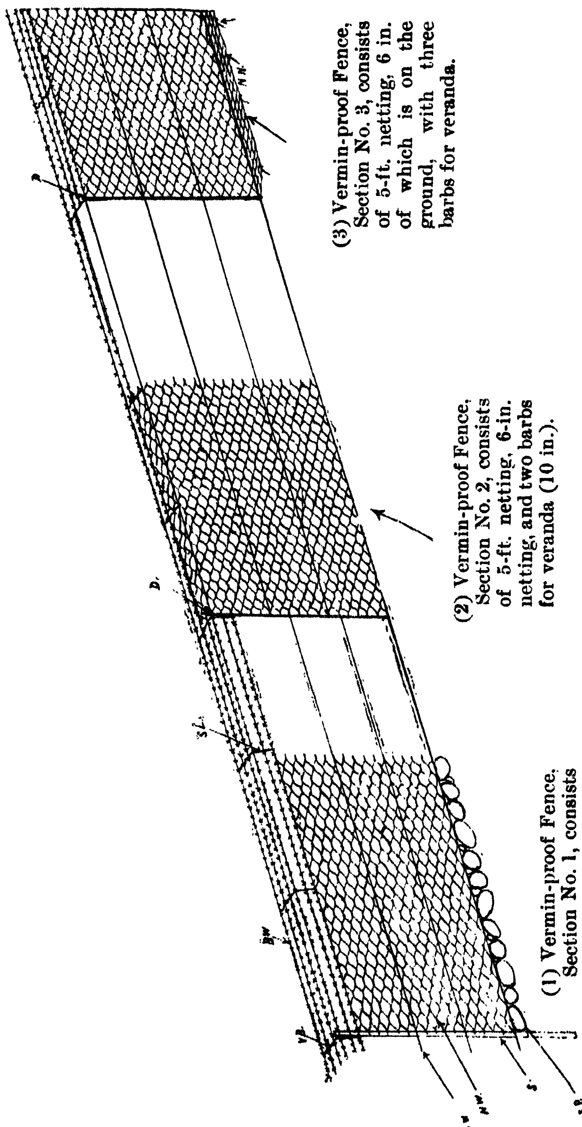
Stone-packing on both sides of the fence is desirable, but not essential, especially where the stones are scarce and must be carted. The stones should be fairly large, especially when packing on the one side of the fence only, so as to make their shifting less easy, if not impossible, but not so large as to materially reduce the height of the fence and incidentally afford a "stand" for the jackal. Where flat stones are obtainable, single slabs passed through half-way under the bottom wire make a more perfect packing, in

which case the bottom wire and netting can be raised six or more inches from the ground, and thus be profitably utilized in heightening the fence. If stones are not available, then 9 to 12 inches of netting is the next best thing, as shown in fig. 2, section 3.

Figure 4 shows an effective and very substantial all-barbed-wire fence, but this type of fence is not recommended owing to the high

FIG. 2.

(For convenience in printing, this sketch, which represents a continuous fence of varying character, has been divided into two portions.)



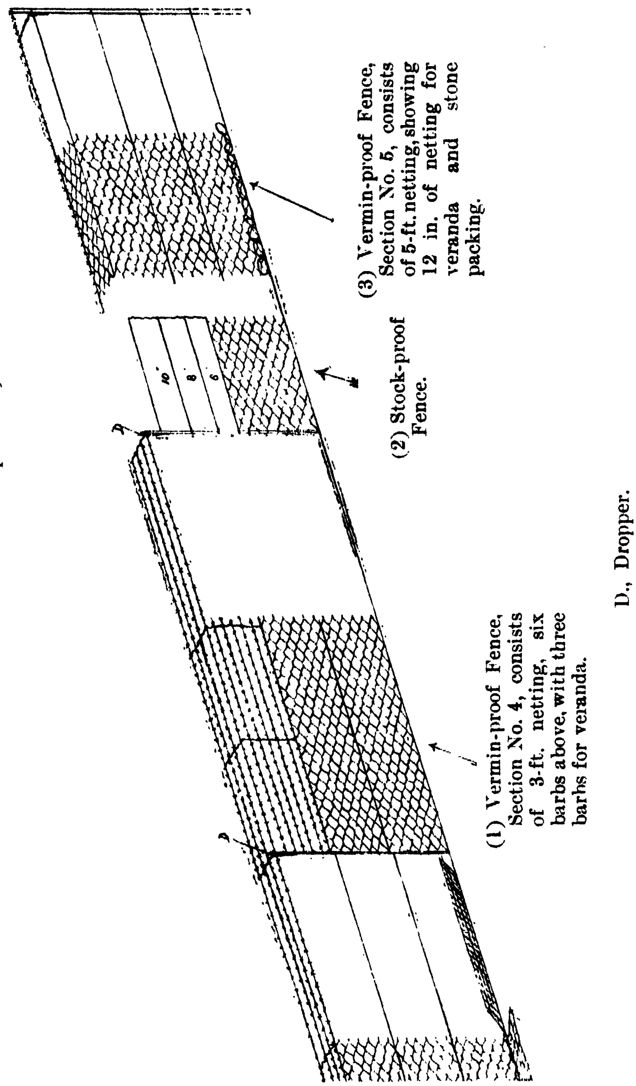
S., Iron Standard; D., Dropper; P.W., Plain Wire; N.W., Netting Wire; P.W., Barbed Wire; V.B., Veranda Bracket; S.L., Short Lace; S.P. Stone Packing; W.P., Wire Pegs; N.N., Netting on Ground.

cost of construction and the extreme care and exactness that must be exercised to erect it successfully. It is a very substantial and useful fence where large stock or game are kept, but few fencers care to undertake its construction.

Figure 5 is a photograph of an existing stock-proof fence, converted vermin-proof, and is reproduced to show the "flexible top" and the manner in which it is held upright where the fence goes over a rise, the highest point here showing at the same time the method of straining the flexible section three wires.

FIG. 2—(*continued*).

(For convenience in printing, this sketch, which represents a continuous fence of varying character, has been divided into two portions.)



COST OF VERMIN-PROOF.

Specification A.—The cost of erecting a vermin-proof fence depends largely on the type of fence and the material used, also the nature of the ground over which the fence is to be erected, also the rate of pay for construction work, but a fence of the following description works out at approximately £49. 10s. per 1,000 yards,

including wages for erection and stone-packing at £13 per 1,000 yards: 16-lb. iron standards, 15 yards apart; 2½-inch top pine droppers, 3 yards apart; 3-foot netting, 3-inch mesh and 15 gauge, supported by two plain No. 8 and one barbed wire, three high-strain No. 12½, and three No. 14 barbed wires alternately above the netting, spaced 3, 3, 3, 3½, and 4 inches apart, and laced every three feet down to top of netting with Nos. 9 and 10 wire alternately; the two top wires forming the flexible section. The cost includes one 14-foot gate over 4,000 yards and selected sneezewood poles for gate and straining posts. Stones are carted anything from 200 yards to 2 miles. It may be mentioned that 3-foot netting instead of 4-foot netting is recommended where horses, donkeys, and cattle are kept, as the 4-foot netting is very often damaged by animals rubbing against it at, or above, the 3-foot line.

If there is no gate in the fence and all 12½ gauge steel wire is used instead of No. 8, the cost is reduced to about £45 or £46 per 1,000 yards.

Specification B.—(To reduce fractions to a minimum, calculations are made over a distance of 4,000 yards.)

		£	s.	d.
4,000 yards ÷ 400 = 10 straining-posts, at 5s. 6d.	=	2	15	0
4,000 yards ÷ 15 = 266 − 10 = 256 16-lb. iron standards, at 1s. 8d.	=	21	6	8
4 extra posts for gate, at 6s.	=	1	4	0
4,000 ÷ 3 = 1,333 − 12 straining-posts = 1,321 − 256 iron standards = 1,065 droppers, at £8. 12s. per 1,000	=	9	3	2
80 rolls, 50 yards, 3 feet × 3-inch mesh × 15 gauge netting, at 13s. 7d.	=	54	6	8
4,000 × 2 = 8,000 ÷ 440 = 18 rolls No. 8 plain galvanized wire, at 14s. 9d.	=	13	5	6
4,000 × 4 = 16,000 ÷ 700 = 23 rolls No. 14 barbed-wire, at 20s. 2¼d.	=	23	4	9
4,000 × 3 = 12,000 ÷ 1,000 = 12 rolls No. 12 high-strain wire, at 19s. 4d.	=	11	12	0
8 rolls No. 10, for lacing and droppers, at 16s.	=	6	8	0
½ roll No. 16 for netting, at 19s. 9d.	=	0	9	9
1 14-foot gate	=	2	17	0
4,000 yards erection, at £13	=	52	0	0
TOTAL		£198	12	6

(Or £49. 13s. 2d. per 1,000 yards.)

If the two No. 8 plain wires are replaced by No. 12 high-strain, then the cost will be reduced by £5. 10s. 10d., leaving an aggregate of £193. 1s 9d., or £48. 5s. 5d. per 1,000 yards.

HOW TO GET CONTRIBUTIONS DECLARED OBLIGATORY.

The Divisional Council has to recommend to the Governor-General, through the Minister of Agriculture, that contributions be declared obligatory in its division, but before it can submit such a recommendation it has to give one month's notice in a newspaper

in which the Council's notices generally appear of its intention to pass a resolution at any ordinary meeting embodying such recommendation. If the resolution is adopted, the Council submits the recommendation to the Minister, accompanied by a certified copy of the resolution and proof that the notice of intention to recommend has been duly advertised.

The Governor-General then either approves of or rejects the recommendation; if the former, a proclamation is published in the *Government Gazette* declaring contributions towards the cost of boundary fences by adjoining owners obligatory in the division concerned; thereafter adjoining owners must contribute towards the cost of erecting boundary fences, whether they make beneficial use thereof or not, provided the formalities of the law are duly complied with.

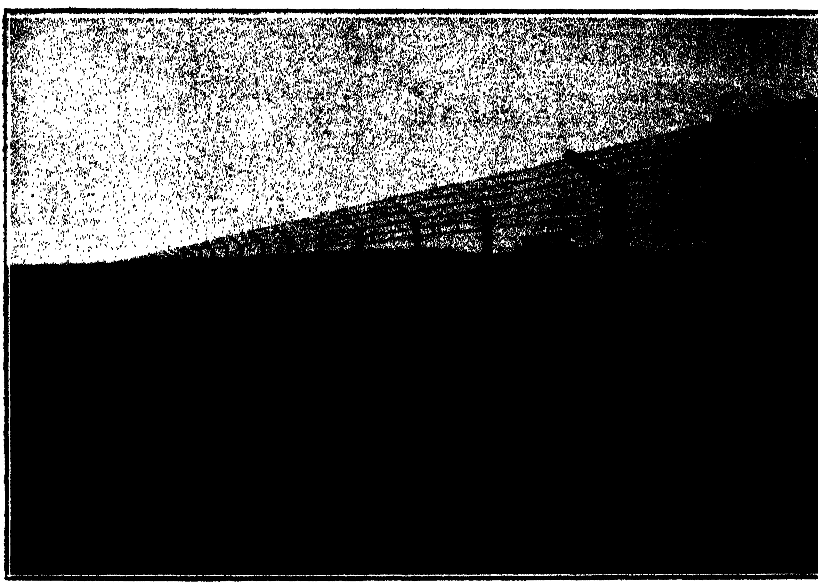


FIG 3.

The Divisional Council may recommend that the law be applied to the whole division under its jurisdiction or to any number of wards in that division. Should one or more wards be left out and the majority in the ward desire to have the law applied, then a petition to the Council, signed by property owners of such ward, generally has the desired effect.

NOTICE TO NEIGHBOURS OF INTENTION TO FENCE.

In order to comply with the formality of the law, it is necessary to give written notice to neighbours of intention to erect boundary fences, whether ordinary or vermin-proof fences, giving details of material to be used and specification of fence generally, together with estimated cost. An adjoining owner whose property is situated in an unproclaimed district or ward cannot be compelled to contribute

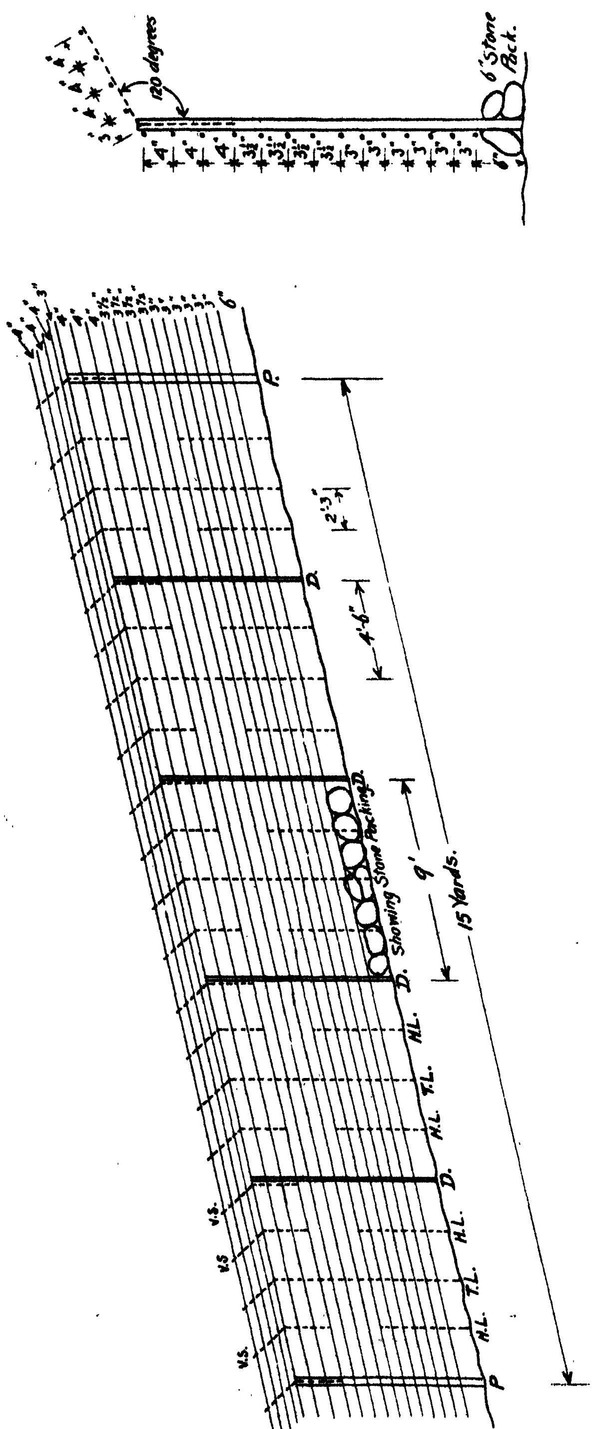


FIG. 4.—Spacing of Posts, Droppers, Laces, and Wires.

P., Post; D., Dropper; T.L., Through Lace; H.L., Half Lace; V.S., Veranda Support.

towards the cost of a boundary fence until he makes beneficial use thereof; but it is, nevertheless, advisable to give him notice in the prescribed way, as it might facilitate the adjustment of accounts when contributions in such district or ward are eventually declared obligatory. If adjoining owners cannot agree on the type of fence to be erected, or any other matter in dispute therewith, such difference or dispute is submitted to arbitration for adjudication, and the verdict is binding on all parties concerned.

HOW TO OBTAIN LAND BANK ASSISTANCE.

(1) If any person desires to fence his farm, he may obtain from the Land Bank an advance for that purpose, provided he is qualified

FIG. 5.—Vermin-proof Fence.

therefor. He should, in the first place, ask the magistrate or the Land Bank to supply him with a form of application (Form No. 3).

(2) Advances under the Fencing Act can be made for the following purposes:—

(*a*) Boundary fencing, whether vermin-proof or stock-proof.

(*b*) Internal or paddock fencing.

(*c*) Altering or improving an existing fence.

(*d*) Paying the contribution towards the cost of a dividing fence which has been erected or improved by a neighbouring owner.

(*e*) Fencing the outside boundaries of a block of holdings.

(3) No loan can be granted unless—

(*a*) application is made and the loan is approved of by the Land Bank before the work of erecting the fence has commenced;

(*b*) the applicant must be the registered owner, in the Deeds Office, of the property which is to be fenced;

(*c*) the property must be defined, that is to say, it must have been surveyed and have been registered in the Deeds Office as a defined portion of land; if it is held in undivided shares, no advance can be made unless all the co-owners join in the application.

(4) Fencing advances are secured, not by mortgage, but by a note which is made by the Registrar of Deeds on the title-deeds of the property and in the books of the Deeds Office. The effect of this note is to prevent any transfer of that property without the consent of the Land Bank until such time as the amount of the fencing charge has been paid. The law, however, provides that if all instalments and interest due for the time being have been paid, the property can be transferred to any other person, and the subsequent transferee will be liable for the instalments that fall due in respect of the fencing advance in the same way as if the advance had originally been made to him.

(5) If the property is bonded, it is advisable for the applicant, before proceeding with the application, to ascertain whether the bondholder has no objection to the fencing advance. In the ordinary course bondholders raise no objection, for the reason that the fencing erected out of the advance constitutes an improvement on the property and because, in the event of foreclosure, the balance of the advance could be taken over by the purchaser of the property.

(6) Fencing advances exceeding £30 are made for a period of twelve years, the rate of interest at present being 5 per cent. per annum. At the end of the first year interest only is payable, and thereafter the advance is repayable in eleven equal yearly instalments, which include capital and interest. The instalment works out at the rate of £12. 0s. 9d. per £100 of the advance. Advances of £30 and under are repayable within five years.

(7) Should the advance exceed £100, it can be paid out in instalments as the work progresses, but not exceeding three instalments, and in any event satisfactory evidence on the form prescribed by the Bank, signed by the stock inspector or some other person whom the magistrate certifies as competent, must be lodged with the Bank. In cases where the material is purchased on credit and the amount of the advance exceeds £200, the Bank will pay out the first instalment of one-third of the advance to the supplier of the material if the applicant authorizes the Bank to do so.

(8) It must be emphasized that applicants should carefully read through the application form before making application and that they should see that all questions on the form are answered in detail. Particularly should they be careful with the specification of the fence, as no advance can be approved unless the Department of Agriculture certifies that the specification is satisfactory and that the amount applied for represents a fair estimate of the cost of the

fencing. Unless full details are given in the form, it means that delay will ensue.

(9) It is no use applying for a loan from the Land Bank for fencing unless the applicant has the title-deeds of the property to be charged, and these title-deeds must be sent with the form of application to the Land Bank at Pretoria.

(10) Any official of the Bank, or of the Magistrate's Office, will be pleased to assist any applicant in filling in the form of application.

DETAILS REQUIRED BY THE DEPARTMENT OF AGRICULTURE.

Before the Land Bank authorizes any fencing advance, it sends the application (on Form No. 3) to the Department of Agriculture for its recommendations. These will only be forthcoming if the Department is satisfied that the specifications and estimated cost of the fencing are considered satisfactory, and applicants should pay special attention to the following requirements on page 3 of the form:—

(1) If the advance is required to erect fencing, the specification should be shown in column "A" below. Only the length of fencing which the applicant intends to erect should be shown.

(2) If the advance is required to alter, improve, or repair an existing fence, state in column "A" the specification of the existing fence and in column "B" the specification of the fence as it will be after the alteration, improvement, or repair has been completed.

(3) If the advance is required to meet a contribution to the cost of a dividing fence already erected by an adjoining owner, the specification of that fence should be shown in column "A." Only the length of fencing in respect of which the applicant must pay should be shown.

(4) In case of vermin-proof fencing, state the reason where all the boundaries of the property are not at present being fenced.

	"A."	"B."
(*a*) Approximate length in yards ...	....	....
(*b*) Number of strands of plain wire (state gauge and make)	....	....
(*c*) Number of strands of barbed-wire (state gauge and make) ...	....	....
(*d*) Kind of standards and weight (if wood is to be used, state kind)	....	....
(*e*) Distance between standards	....	....
(*f*) Number of droppers between standards (state kind)	....	....
(*g*) Distance between straining-posts	....	....
(*h*) Kind of straining-posts (if wood is to be used, state kind)	....	....
(*i*) Description of wire-netting (if any)	....	....

N.B.—The Department of Agriculture will not approve of a fence consisting of less than five strands of barbed-wire or six strands of plain wire. Where both barbed and plain wire are used, the minimum of five wires will be allowed only if at least three barbed wires are used and the balance plain wires, otherwise six strands will be necessary. In the former case, the lowest, centre, and top wire must be barbed. Standards must not be more than 20 yards apart, nor must straining-posts be more than 500 yards apart.

Between standards 20, 15, 10, and 5 yards apart, at least 4, 3, 2, and 1 droppers respectively must be inserted. If the distances apart are between those mentioned, the number of droppers required is that for the next longer distance, e.g. for 16 yards 4 droppers are required. The Department of Agriculture does not usually pass barbed-wire of less than 14 gauge and plain wire of less than 8 gauge, except where a special recognized brand is used, which must be stated. Resiststeel or high-strain wire having a breaking strain corresponding with or greater than the type of wire mentioned above will, however, be passed.

All wire should be properly galvanized. Standards 5 to 14 yards apart must be at least 14 lb. in weight; and 15 to 20 yards apart, at least 18 lb. in weight. Wooden droppers must be at least of 2-inch top when soft wood is used and 1½-inch top when hard wood is used. If laces are used instead of droppers, they must be at least 2-ply No. 8 gauge or 4-ply of any thinner wire: when these laces are used, the application must be accompanied by a certificate by a magistrate or stock inspector that wooden droppers are unsuitable owing to risk of destruction by grass-fires or ants. All applications for vermin-proof fencing must be accompanied by a diagram or description of the fence proposed to be erected, giving the height of the wire-netting, the number of strands of barbed and plain wire, and the proposed distance between such strands of wire in relation to the wire-netting.

Importation of Second-hand Bags: Warning.

Importers of second-hand bags are cautioned to take adequate precautions against the inclusion of bags that have contained cotton or cotton-seed in consignments shipped to them. The Department of Agriculture drastically restricts the importation of cotton and cotton-seed, and applies the restrictions to bags that are seen to be contaminated with these articles. It is impracticable to cleanse or disinfect the bags and impracticable for the inspectors to separate those in which cotton or cotton-seed is present from those which may be free of the contamination. Hence if any cotton or cotton-seed is found in a bale of bags, the whole bale is excluded from entry. Bags in which cotton or cotton-seed has been transported are almost sure to retain some of the article.

RED SCALE AND FUSICLADIUM CONTROL IN PEAR ORCHARDS.

Orchard Spray Experiments at Elsenburg during 1923-24.

By F. W. PETTEY, Ph.P., Entomologist, Elsenburg School of Agriculture and Experiment Station.

THE severity of red scale (*Chrysomphalus aurantii*) in the western districts of the Cape Province pear orchards and the questionable efficiency of lime-sulphur in its control, as well as the desirability of determining the most effective and economical method of controlling this pest, have justified the continuation of spray experiments with several kinds of insecticides for five years. The results of the investigations with reference to this subject for 1920-1921, 1921-1922, and 1922-1923 may be found in references (1), (2), and (3) at the end of this paper. During the 1924-1925 fruit season the trials of practically the same insecticides as tested the previous year were repeated. They consisted of comparative trials of scalecide, harbas, a home-made lubricating engine-oil emulsion, and various dilutions and applications of lime-sulphur to determine their relative efficiency.

EQUIPMENT AND MATERIALS FOR SPRAYING.

A petrol sprayer of 3 horse-power, which maintained a pressure of 200 lb., was used in the experiments. It was equipped with two spray-rods, each with a line of hose and a single-angled nozzle, furnishing a whirling spray through a flat disc with an opening of medium size.

The strength of the Capex lime-sulphur stock solution was not tested, but it was assumed that the concentration stated on the labels was correct, since tests confirmed it in 1921. At that time it was found that a dilution of 1 measure of the lime-sulphur in 10 measures water gave a concentration of about 4 degrees beaumé; 1 in 9 gave 4 to 5 degrees. The material has always been put up in air-tight iron drums. Drums of lime-sulphur found to contain crystallized material at the bottom were heated to dissolve it before the material was used.

Harbas and scalecide were diluted according to the directions on the labels for scale-insect control, i.e. 1 measure of scalecide in 15 measures of water and 1 measure of harbas in 20 measures of water. Some plots were treated with 1 measure of harbas in 15 measures of water.

The home-made engine-oil stock emulsion was made according to the following formula, which is similar to that widely used in the United States for pernicious scale control:—

Standard oil No. 8	2 gallons.
H. & S. soft soap	2 lb.
Water	1 gallon.

The materials were placed in a receptacle and heated until the mixture began to boil. After about 15 minutes of boiling, when the soap had dissolved, the mixture was removed from the fire and pumped vigorously, while hot, twice through a small bucket-pump, after having removed the cap and disc of the nozzle. In other words, the material was pumped from the one receptacle into another and then pumped back into the original receptacle. This formed a stock solution of emulsified oil. The solution was then placed in the spray tank, and 46 gallons of water were added to it, slowly at first, while being vigorously stirred, or while the engine was running. So the spray consisted of 1 measure of stock solution oil emulsion in 15 measures of water.

H. & S. soft soap is a potash fish-oil soap. Standard oil No. 8 was said by the dealer to approach the following characteristics: Specific gravity at 20 degrees C., .914; viscosity (20 degrees C.) (Engler), 17.31. Probably any light engine-oil of similar characteristics, such as Nabob, Red Neutral, and Lion brand "C" would give as good results.

GENERAL ARRANGEMENT OF SPRAY PLOTS.

All spray plots, arranged parallel, consisted of at least three rows of fruit trees, and those trees selected for records occupied, when possible, the middle row of each plot.

INFLUENCE OF CLIMATIC CONDITIONS ON THE EFFICIENCY OF SPRAYS.

The climatic conditions prevailing during the 1922 spraying season were considerably more favourable to the efficiency of sprays than during the 1923 and 1924 seasons (see Table 1). In 1922 there were only 11 days of rain during September and October, in comparison with 21 days in 1923 and 22 days of rain in 1924 during these months. The monthly mean temperature for September, 1922, was 58.1 degrees F., in comparison with 54.4 and 56.2 for 1923 and 1924 respectively. In tests of the ability of oil and other sprays to resist washing from rain in Massachusetts, Hood found that 40 per cent. of a mixture of 1 gallon of miscible oil in 100 gallons of water was washed off in about one month's time, during which there was about 2 inches of rainfall. The odour of sulphur-dioxide vapour from trees sprayed with lime-sulphur is very pronounced in an orchard on warm sunny days in spring, but it is scarcely noticeable on cold days. As this vapour destroys any hatching scale insects born from mother scale insects not destroyed by the winter application, it is evident that a spray applied as late in winter as possible, with a number of days of warm sunny weather immediately following, to cause young scale insects to hatch when the vapour is concentrated, are going to have maximum efficiency in the control of the pest.

THE RESULTS AND CONCLUSIONS.

The records of the results of the experimental spraying during 1923 and 1924 may be found in Tables 2 and 3.

Paraffin emulsion, diluted at the rate of 1 measure in 20 measures of water, applied in late winter when buds were swelling, was not effective in the control of red scale on Kieffer and Duchesse pears and cannot be recommended.

Harbas miscible oil, diluted at the rate of 1 measure in 20 measures of water, which was the dilution recommended on the label of the receptacle for the control of scale insects, applied in late winter when the buds were swelling, was not so effective as scalecide diluted at the rate of 1 gallon in 15 gallons of water, applied at the same time, but harbas used at the same dilution as scalecide gave practically as good results as the latter.

Home-made engine-oil stock emulsion, diluted at the rate of 1 measure in 15 measures of water, applied in late winter when buds were swelling, was found to be two to three times as cheap as the proprietary miscible oils and more effective in the control of the pest in 1924. It was cheaper than lime-sulphur diluted 1-10 and much more effective in cases of severe infestation. The records in Table 2 show that the infestation of Kieffer (*a*) pears at harvesting time in 1924 were:—Home-made lubricating oil emulsion (1-15), 6 per cent.; scalecide (1-15), 15 per cent.; harbas (1-20), 46 per cent.; lime-sulphur (1-10, plus spreader), 47 per cent. In Kieffer (*b*) pears the infestation was:—Scalecide (1-15), 15 per cent.; harbas (1-20), 29 per cent.; home-made lubricating oil emulsion (1-15), 12 per cent. In the same year the infestation of Duchesse pears was:—Harbas (1-20), 16 per cent.; home-made lubricating oil emulsion (1-15), 2.7 per cent.; lime-sulphur (1-10, followed by 1-75, plus spreader), 45 per cent.

A single dormant late winter spray of lime-sulphur, applied when the buds were swelling, at the rate of 1 gallon in 10 gallons of water, without spreader, has not satisfactorily controlled red scale on early blossoming varieties of pears, but has controlled for several seasons a light infestation on Beurré Hardy pears, a late blossoming variety, which allowed the spray to be applied several weeks later than on the Kieffer. Beurré Hardy trees sprayed in 1922, 1923, and 1924 resulted in the fruit having an infestation, at harvesting time, of 1.8, 2.4, and 2.7 per cent. respectively, but Kieffer pears, sprayed with the same mixture and with spreader added, showed an infestation of 2.8 per cent. in 1923 and 47 per cent. in 1924. The better control in the Kieffer variety in 1923 was due largely to a small infestation the previous season as a result of two applications of lime-sulphur on the trees as well as a spring of very little rainfall.

A late winter spray of lime-sulphur, diluted 1-10, applied in late winter when the buds were swelling, followed by a lime-sulphur spray, diluted 1-50, applied when the flower-buds were pink, successfully controlled during 1923 and 1924 the pest on Louise Bonne pears, but did not control it on Forelle pears in 1924, apparently because the latter had to be sprayed several weeks earlier, being an early blossoming variety. The Louise Bonne pears showed, when harvested, an infestation of 1.7 per cent. in 1923 and 3.3 per cent. in 1924 as a result of these applications, while the Forelle variety was 28 per cent. infested. However, an additional application of lime-sulphur, diluted 1-50, on Forelle pears in 1923 gave good results (Table 2).

A late winter spray of lime-sulphur, diluted 1-10, followed by an application diluted 1-60, applied when blossom buds were pink, and two later sprays, diluted 1-75 or 1-80, plus spreader, put on with lead arsenate during the first two codling sprays, satisfactorily controlled both red scale and fusicladium on Louise Bonne pears for the two consecutive seasons of 1923 and 1924, without causing much burning of foliage. The same applications well controlled fusicladium on Forelle pears, but did not satisfactorily control red scale on this variety. An additional application, diluted 1-75, plus spreader, put on when about half the petals had dropped, gave good results in 1923 (Table 2).

WHAT SHOULD BE THE SPRAY PROGRAMME FOR RED SCALE, FUSICLADIUM, AND MITE CONTROL IN THE PEAR ORCHARDS OF THE CAPE COASTAL DISTRICTS?

Rainfall, elevation, temperature, humidity, fertility, and depth of soils vary so much in the coastal districts that no hard and fast rules can be made for the control of these pests for these areas as a whole. Red scale is notorious for flourishing most on fruit trees which are exposed to drought due to shallow soil or bad cultivation, are not well fertilized, are in poor soil, or are not constitutionally strong. Bryobia mite flourishes most during a dry spring and summer or in areas where the spring and summer are hot and dry. Fusicladium attacks varieties in some orchards more severely than in others, depending on humidity and the amount of late spring and early summer rains. Some varieties are naturally more susceptible to attack from these pests than others.

In the Elsenburg orchard, among the more important varieties, red scale flourishes most on Kieffer, Duchesse, Comice, Beurré Bosc, and White Doyenne pears. Varieties less severely attacked are Louise Bonne, Forelle, Jarganelle, Clapp's Favourite, Glout Morceau, Winter Nelis, Beurré Hardy, and Williams. The last three are the least attacked of all. Those most susceptible to fusicladium are, in order of the usual degree of infestation, Forelle, Louise Bonne, Winter Nelis, Beurré Bosc, Clapps Favourite, Beurré Diel, and Williams. Comice, Duchesse, Beurré Hardy, Kieffer, Glout Morceau, and Bergamotte are so little infested, if at all, that they require no treatment. Williams occasionally requires one treatment when the rains do not stop until after the petals have dropped. In some orchards, however, this variety is severely attacked, and requires three or four fusicladium sprays.

The facts of most interest to fruit growers, resulting from these orchard spray experiments are: A home-made lubricating oil stock emulsion, diluted 1-15, which is at present two to three times cheaper than proprietary miscible oils and equally, if not more, effective than the latter, will satisfactorily control red scale on both late and early blossoming varieties of pears. The home-made material has the only disadvantage of requiring some time and care in making. The fruit grower who adopts it should strictly follow the methods of making it described in this paper. The soap used for the present should be H. & S. soft soap, a potash fish-oil soap, said to be free from rosin oil and sulphuric acid. It should not be applied after the buds are open.

If lime-sulphur sprays are used for the control of red scale, mites, and fusicladium, the dilutions and applications should be determined by the time of blossoming of the different varieties, their susceptibility to attack by each pest, and their degree of infestation.

A CHEAP AND EFFICIENT SPRAY PROGRAMME FOR PEAR ORCHARDS.

Taking into consideration the varying climatic conditions and experimental spray records over a series of five years, the following spray programme for the control of red scale, mites, and fusicladium is suggested to be the most economical and practical for the Elsenburg orchard and districts subject to similar climatic conditions: Spray all red scale infested pear varieties with an application of home-made lubricating oil emulsion at the rate of 1 measure of the stock solution in 15 measures of water. If experience shows that this late winter spray does not sufficiently control Bryobia mite or the bud mite on certain varieties, apply an additional pink bud spray of lime-sulphur, diluted at the rate of 1 measure in 75 measures of water, adding about 1 lb. of Capex spreader to every 75 gallons. Pear varieties susceptible to fusicladium should, in addition to these two sprays, receive two later applications of either bordeaux (4-4-50 formula) or lime-sulphur, diluted 1-75, plus spreader, put on with lead arsenate at the time of the first two codling sprays.

Fruit growers who can afford to pay for the convenience of using an oil spray already prepared for mixing with water may substitute for the home-made oil emulsion a proprietary miscible oil, diluted at the rate of 1 measure in 15 of water. But this will be considerably more expensive than the home-made emulsion.

Experiments now in progress at Elsenburg with a cold home-made lubricating oil emulsion, using calcium caseinate and fusel oil as emulsifiers, may result in the fruit grower being able to make on the farm, with little trouble or time required, and use a satisfactory oil emulsion for red scale control that does not necessitate boiling.

A LIME-SULPHUR SPRAY PROGRAMME FOR PEAR ORCHARDS.

To fruit growers who desire to make as much use of lime-sulphur as possible in their spray programme because of the fact that it is fairly cheap, is easily prepared for spraying on the trees, and is both a fungicide and insecticide, the following programme is suggested for districts where climatic and other conditions are similar to those at Elsenburg.

For Kieffer pears and other varieties blossoming equally early, which are generally considerably infested with red scale or mites or both, and not susceptible to fusicladium, a late winter spray of either home-made lubricating oil emulsion or a proprietary miscible oil, diluted 1-15, and applied when the buds begin to swell is advised. If experience shows that the pear-bud mite is not sufficiently controlled by this application, an additional spray of Capex lime-sulphur, diluted 1-75, plus ¾ lb. of calcium caseinate spreader (Capex spreader) for every 75 gallons, is recommended to be applied at the time the blossom buds are green or pink. Home-made lubricating oil emulsion is at present at least twice cheaper than proprietary miscible oils and is equally or more effective, but requires some care and time to make.

A spray of lime-sulphur, diluted 1-10, with or without spreader, applied as late in winter as possible when the buds are swelling, followed by an application, diluted 1-50, plus spreader, when the flower buds are green or pink, is suitable for pears blossoming late, attacked by red scale and mites, and only slightly susceptible to fusicladium, such as Duchesse, Glout Morceau, Comice, and Beurré Hardy. When any of these varieties or similar ones are only slightly infested with red scale and the bud mite, the flower-bud or second spray may either be reduced to 1-75, plus spreader, or omitted. Williams pears may be included for this programme in valleys where it is not usually severely attacked by fusicladium. The little foliage burning that may result some seasons after the application of the flower-bud spray apparently has no bad effect on the crop of fruit or on the vitality of the tree.

Varieties attacked by red scale, mites, and fusicladium have been successfully treated in the Elsenburg orchard during 1923 and 1924, with no appreciable burning of foliage, by four sprays, the first consisting of lime-sulphur, diluted 1-10, applied when buds were swelling; the second, lime-sulphur, diluted 1-50, plus spreader, applied when buds were pink; and the third and fourth, consisting of lime-sulphur, diluted 1-75 or 1-80, plus spreader, applied at the time of the first two codling sprays. The varieties so infested at Elsenburg are: Clapp's Favourite, Forelle, Louise Bonne, Beurré Bosc. Winter Nelis, and Jarganelle. Bordeaux (4-4-50) may be substituted for the last two sprays, if experience shows that much burning results, and if fusicladium is very bad and scale infestation is rather light. Bordeaux, however, is more expensive than the lime-sulphur sprays mentioned.

It has been found unnecessary to give two blossom-bud applications of a fungicide in the Elsenburg orchard to satisfactorily control fusicladium. This disease has not been evident in the Elsenburg orchard until after nearly all petals of late blossoming varieties have dropped, and a week or two after early blossoming varieties, such as Forelle and Jarganelle, have dropped their petals. It is at the same time recognized that the fungicide must be applied before the disease is evident.

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2. "The Control of Red Scale in Pear Orchards," by F. W. Pettey, Union of South Africa Department of Agriculture. Reprint No. 39, 1922, from the *Journal of the Department of Agriculture*, October, 1922.

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(NOTE.—The tables referred to will be published, together with the article, in bulletin form, obtainable on application to this office.—EDITOR.)

COTTON FERTILIZER TRIALS.

By THOS. D. HALL, Chemist, School of Agriculture and Experiment Station, Potchefstroom.

THE area of land under cotton in the Union has increased so rapidly during the past few years that any means of increasing the yields per acre and of decreasing the costs of production will be of more than passing interest to growers.

A co-operative fertilizer experiment was carried out this past season with the generous help of Messrs. E. E. and E. A. Galpin, of Mosdene, Naboomspruit, on a red sandy loam, with the object of ascertaining whether phosphatic, nitrogenous, potassic, and calcareous fertilizers would be profitable on cotton on this soil type.

1. *Bad Effects of Lime.*—One of the outstanding observations was the depressing effect of 500 lb. per acre of carbonate of lime on the quantity as well as the quality of the cotton. Whether used alone or with various combinations of other fertilizers, this bad effect was apparent. The lime depressed the yield approximately 32 lb. per acre, and caused a loss of at least 18s. per acre, even when the lowered quality of the cotton was not taken into account.

This observation is in accordance with Texas experiments carried out for several years. It was found there that lime consistently depressed the cotton yields in about the same degree as recorded at Naboomspruit. Texas is the highest producer of all the American cotton states, as well as the one whose climatic conditions approximate most closely to those of our own cotton belt, and for those reasons these results will be of more than usual interest.

2. *Benefits from Phosphates and Nitrogen.*

(*a*) Of all the single constituent fertilizers tried superphosphate gave the best returns.

(*b*) Superphosphates and ammonium sulphate together, however, gave the highest and most profitable increase (£4. 17s. per acre).

(*c*) Mixtures of equal parts of superphosphates and Langebaan rock phosphate at the rate of 300 lb. per acre, gave nearly as good results as superphosphate alone at the same rate.

(*d*) The rock phosphate alone and mixed with nitrogenous and potassic fertilizers was, however, not at all satisfactory.

3. *No Benefits from Potash.*—Muriate of potash with rock phosphate, with superphosphate, and with phosphate and nitrogen did not give any increase in yield or any improvement in quality.

Recommendations Based on this Experiment.

The following amounts of fertilizers can be used per acre for cotton. Farmers who make correct use of a legume crop in their rotations can, however, dispense with the nitrogenous constituents.

(1) 150 lb. superphosphate, 50 lb. sulphate of ammonia;

(2) or 150 lb. superphosphate, 66 lb. nitrate of soda;

(3) or 100 lb. superphosphate, 50 lb. rock phosphate, 66 lb. nitrate of soda;

(4) or 100 lb. superphosphate, 50 lb. rock phosphate, 50 lb. sulphate of ammonia;

(5) or 75 lb. superphosphate, 75 bone-meal, 25 lb. sulphate of ammonia;

(6) or 75 lb. superphosphate, 75 bone-meal, 33 lb. nitrate of soda.

These mixtures should cost about 18s. to 19s. per acre in the cotton belt.

All the details of this experiment, together with a summary of American cotton fertilizer experiments in general and Texas experiments in particular, will be published at an early date.

Outbreaks of Animal Diseases: August, 1925.

Disease.	Transvaal.	Natal.	Cape.	Orange Free State.	Transkei.	Total for Aug., 1925.	Total for Calendar Year. 1924.
East Coast Fever	—	1	—	—	1	2	125
Mange	31	22	18	11	34	116	455
Anthrax	11	1	5	13	15	45	1,494
Dourine	—	—	2	—	—	2	14
Glanders	—	—	3	—	—	3	56
Tuberculosis	—	—	1	—	—	1	18
Epizootic Lymphangitis	—	—	—	—	—	—	2

PRICKLY PEAR AND ENSILAGE.

A Farmer's Experience.

Mr. A. Stead, Senior Chemist, Department of Agriculture, records the following interesting information:—

Mr. T. Murray, of Murray Brothers, Roodebloem and Bloemhof, Graaff-Reinet, was good enough to tell me of his experience in connexion with prickly pear and ensilage.

He stated that, up to the present, he had not fed any Burbank prickly pear, his energies hitherto having been confined to establishing a large acreage thereof. He is establishing plantations at as many points as possible with a view to facilitating feeding sheep and cattle later on, when the veld is dry. The total area under prickly pear to-day is about sixty-four acres, and this has all come in about five years from about forty leaves, some of which he obtained from the late Mr. Walter Rubidge, some from Grootfontein, and some from Pretoria.

Method of Planting.—The leaves are planted in single or double rows, 6 feet to 10 feet apart, the distance between plants in the rows being 3 feet. He has found the most satisfactory and expeditious method of planting to open the soil, by inserting a spade, and in the opening to put a leaf to such a depth that about one half of its length is below ground.

"It is a good thing," Mr. Murray said, "to let the leaves dry for a few days before planting them; for then they are not so easily bruised when handled or carted." Mr. Murray says no water should be given them for the first year or two; but thereafter, they should get whatever floodwater can be spared.

Ensilage.—His experience with regard to ensilage is limited to sunflower and maize. He has found that stock prefer ensilage made from the latter; also that maize gives a much better yield than sunflower does on fertile soil such as he has at Roodebloem.

His first silo was of the trench variety, and of about 100 tons capacity. This was abandoned owing to the excessive waste of good food unavoidable with this type of silo. He has now a circular brick silo 15 feet in diameter, 12 feet below, and 8 feet above ground. The brickwork below ground is 4½ inches; above, 9 inches. Bricks are laid in lime or cement, and pointed or plastered with cement.

In feeding from this silo there is still some waste, but he proposes to reduce this by building in a partition from the floor to the ground level, under which conditions only half the total area will be exposed at a time.

In filling the silo the following procedure is adopted:—Boys provided with sharp spades cut down the mealies (which should have advanced well on the road to maturity). Other boys collect them into bundles which are, however, not tied; others cart them away on wagons; others cut them up into pieces about 1½ inch long—a

chaff-cutter driven by a petrol engine is used for this purpose—and, as the silo is filled, the contents are well tramped.

His practice is to fill the silo to about 6 feet above the wall to allow for shrinkage, and to fill up again as often as necessary. The opening from ground level is planked up as the silo fills.

For the ordinary farmer who does not feed more than a load or two a day, Mr. Murray considers a silo that can be quickly filled is the best. This means that the bulk of the silo should be below ground, unless the farmer is prepared to go to the expense of blowing up the material. The extra time required to take silage out of a below-ground silo is not felt when the silage is being fed, because the quantity used per day is relatively very small in comparison with the quantity handled per day when the silo is being filled.

Mr. Murray's silo holds about 75 tons (50 loads of 3,000 lb. each), or enough to provide 50 head of cattle with 30 lb. each for 100 days.

Cost of Production and Feeding.—Mr. Murray thinks the following details about right:—

		£	s.	d.
(1) Ploughing, seeding, and watering of 12 acres (no weeding is done, the weeds go into the silo) ...		5	0	0
(2) Harvesting, etc.—				
(*a*) 2 men cutting ... ... 2 men bundling .. ... 8 men with wagons ... 5 men with machine, cutting, tramping, etc ...	17 men at 2s. 6d. per day for six days	12	15	0
(*b*) One tin of petrol per day for six days	6 tins at 12s. per tin	3	12	0
(*c*) Three wagons at 15s. per day for six days ...		13	10	0
(3) Feeding:—				
One boy at 2s. 6d. per day for one hundred days (one good boy can feed 50 head of cattle 30 lb. each per day.)		12	10	0
TOTAL ...		£47	7	0

Silage versus *American Aloe.*—Once planted, there is no more planting of American aloe to do; and since the material can be fed on the spot, there are no great cartage costs to consider; merely such as can be done by a wheel-barrow.

2 men can feed 50 head of cattle per day.

2 @ 2s. 6d. per day for 100 days £25 0 0

Roughly, therefore, to produce and feed mealie ensilage costs about twice as much as to produce and feed an equivalent quantity of American aloe.

Silage versus *Prickly Pear.*—Presumably the cost of feeding spineless prickly pear would be less than that of feeding American aloe

THE COTTON INSECT SITUATION.*

By G. C. HAINES, Entomologist in charge of Cotton Insect Investigations.

THIS paper is not a progress report on the cotton insect investigations, but is an attempt to review briefly and concisely the cotton pest situation as it exists to-day. So far, I have recorded nearly 200 insects which, in some way or other, are connected with cotton, but I will mention only the more important ones in the order of their importance.

BOLLWORMS.

Bollworms are the most constantly serious insect pests of cotton in South Africa. There are four species:—The Sudan bollworm, *Diparopsis castanea*; the American bollworm, *Chloridea absoleta*; the spiny bollworm, *Earias insulana*; and the scavenger bollworm, *Pyroderces simplex*. The Sudan bollworm, which, so far as we know, is a pest only of wild or cultivated cotton, is usually considered to be the worst pest of the four, but recent observations seem to indicate that the American bollworm is the predominant species in some localities. The spiny bollworm has always held third place in importance as a pest, and the scavenger bollworm is of very minor importance. Bollworm attacks appear to be cumulative and the degree of abundance of the insects influenced by enemies, weather conditions, soil management, and perhaps other factors unknown to us. Although bollworms are usually found wherever cotton is grown, the worst-infested places seem to be in a horse-shoe shaped area in the Transvaal, running from Rustenburg around the northern end of the Province to Komatipoort.

The more general facts concerning the life-histories of the bollworms are known, and these have been used as the basis for the control measures already recommended. But a more exhaustive study is essential, especially as to the habits and food-plants of these insects, to aid us in finding thoroughly effective methods of control. Few people, especially farmers, realize the difficulties there are in finding satisfactory remedies for internal feeders like the bollworms. Field crops, like cotton, because of the large acreages involved and the comparatively small profit per acre, are difficult to deal with. Spraying and dusting with arsenicals and various other poisons have been tried experimentally, but so far the results obtained have been very discouraging. Culture methods, such as ploughing and cultivations, have also not yet proved effective as general methods of control.

[*This statement on the cotton insect situation was read at the Second Annual Conference of the Division of Entomology, on 30th July, 1925.—EDITOR.]

CONTROL MEASURES.

From our present knowledge of these insects, the most promising control methods appear to be in the line of (1) cultural operations for the destruction of the over-wintering and summer-resting stages of the insects in the soil; (2) dusting or spraying with arsenicals and other insecticides with machines suitable for the control of field-crop pests: (3) trap-cropping with maize for the control of the American bollworm; (4) crop rotations; (5) the growing of resistant strains of cotton; (6) biological control with parasites, enemies, or diseases; (7) other methods of control, such as hand-picking, attractants, repellants, etc. It is hard to say what method of control will prove effective. Of the two more serious bollworm pests, the American bollworm is the more easily controlled. The Sudan bollworm is a different proposition entirely, and the prospects of finding a remedy for it are far from bright.

The losses through bollworm pests have been tremendous in the northern and eastern parts of the Transvaal, as high as 80 and 90 per cent. in some instances, and several cotton growers have been forced to give up growing cotton. I am not satisfied that *all* of these losses are due to the bollworms, but most of them undoubtedly are. The bollworm situation is becoming critical, and many do not realize how serious it is. We must find a remedy, and as soon as possible.

JASSID.

The cotton jassid, *Chlorita fascialis*, ranks second in importance to the bollworm as a pest, and during some seasons rivals it in importance. The area of more serious jassid outbreaks extends from the northern end of the Transvaal down through the low veld of the Eastern Transvaal and Swaziland to the northern end of Natal. The full life-history of the insect has not yet been worked out, but certain factors governing severe outbreaks are known. Among the control measures tried, barriers of fallow ground surrounding the cotton fields may have seemed helpful in some cases. Plants grown on fertile soil seem to resist attack to a considerable extent. It has also been observed that hairiness of leaf and stem give a considerable degree of resistance to attack, probably mechanical. Bordeaux mixture has proved effective as a repellant for jassid, and recent experiments have given very promising results. Recent observations make it clear that some unknown factor—perhaps of weather or soil condition—exists which influences jassid outbreaks. In certain localities the cotton plant appears to be able to withstand jassid attack to a very considerable degree; one striking case being noted where a very susceptible variety yielded an average crop this season, under conditions usually considered favourable to the insect. This brings to mind that at the outset of these investigations soil drainage and local conditions were considered important and influencing factors in jassid outbreaks. These factors should receive further study. During the coming season it is proposed to conduct investigations along two lines, the finding of varieties or strains of cotton that are more or less resistant to jassid attack, and a temporary method of control, such as dusting or spraying with contact poisons and repellants. The relation of the insect to soil fertility, weather conditions, and other factors that may govern its abundance are also being studied. The goal in

jassid control work is to find a resistant strain of cotton, and the prospects of doing so are very bright. On the whole, the chances of finding an effective and practical method of control for the jassid are good.

SEEDLING PESTS.

Every spring cutworms, wireworms, millipedes, snout-beetles, and grasshoppers, somewhere or other, do serious injury to newly planted cotton plants. Damage by such creatures fluctuates in severity according to the season, and may be expected to decrease when lands are better developed and more intensive culture methods prevail. The only really effective and economic way to deal with soil pests attacking field crops is to maintain a close or dead season, preferably for two months or more each winter, during which time no crops or vegetation of any kind is on the land and the lands are under an absolutely bare fallow. Artificial remedies, such as baiting or poisoning, may have to be resorted to during exceptionally severe outbreaks. The seedling pest problem will tend to improve as the cotton-growing industry becomes more stable and farming operations become more intensive.

APHIS.

The cotton aphis, *Aphis gossypii*, is a pest of considerable importance under weather conditions favourable to the insect. The most damage is done early in the season, when the cotton plants may be seriously checked in their growth. There is a need for statistical studies of severe outbreaks throughout the Union, and these should be given attention to in conjunction with jassid studies, as it is quite possible that partially resistant strains of cotton plants may be found. Experiments on control by dusting and spraying should also be conducted.

PLANT-BUGS AND BOLL-ROT.

Boll-rot has become increasingly prevalent during the past few years, mainly in connexion with abnormally wet seasons. Little is known about the diseases causing boll-rot in South Africa, and a thorough study by a mycologist and an entomologist is needed. No satisfactory remedy can be given at present.

BOLL-SHEDDING.

True square- and boll-shedding, which is not caused by insect attack or plant diseases, but is due to various factors which upset the healthy growth of the cotton plant, such as sudden changes in temperature or soil moisture, or interference with the plant's root system, is much more prevalent in South Africa than most cotton growers realize. Some think that boll-shedding is caused almost exclusively by insects, but there is strong evidence that this is not always so. There is need of a thorough study of the conditions influencing boll-shedding, and this should be done in connexion with the study of the different insect pests, especially the bollworms and the plant-bugs.

STAINERS AND LINT-STAINING.

That cotton stainers, *Dysdercus* spp. and *Oxycarenus* spp., are to any great extent lint-stainers, is a debatable question. It is likely these insects do cause some staining, and it is also probable their attacks may cause some shedding of squares and bolls. This problem should be studied along with the study of plant-bugs and boll-rot and of boll-shedding, as all these subjects are closely related.

OCCASIONAL PESTS.

This group contains those insects which only occasionally come into the lime-light as pests of importance; although their outbreaks may be serious, the trouble is usually of brief duration. These insects include various leaf-feeding caterpillars and beetles, the giant cricket, termites, and a root-feeding beetle. The general life-histories of most of these pests have been worked out and various control methods tried, but further studies should be made.

SERIOUS FOREIGN PESTS.

The situation as to serious foreign cotton insects likely to be introduced into the Union is quite satisfactory at present. So far as is known, the pink bollworm, *Platyedra gossypiella*, is not present in any part of the Union of South Africa, nor in Southern Rhodesia, Northern Rhodesia, Nyasaland, nor the southern portion of Portuguese East Africa. It is rumoured that it is present in Portuguese Angola and the extreme northern end of Portuguese East Africa; and it is authentically recorded from Tanganyika and Zanzibar, as well as from most parts of northern and western Africa. It is urged that careful attention be paid to the regulations governing the importation of cotton seed, as it would be disastrous if this extremely serious cotton pest were added to those we already have. A close watch of the situation is being kept at the ports of the Union, also close touch with the authorities in the bordering colonies. What little cotton seed is legally introduced into the Union is carefully inspected and fumigated.

REVIEW OF THE SITUATION AS A WHOLE.

Except for the bollworms, I do not consider the cotton-insect situation alarming, but I do admit that pest investigations must be more vigorously pursued if pace is to be kept with the rapid expansion of the cotton-growing industry, and the enormous losses checked which are occurring yearly in certain parts of the cotton-belt of the Union. The most urgent problem of the moment in these cotton insect investigations is to find effective and practical remedies for the bollworms, and ample facilities must be immediately available if the situation is to be coped with. Of scarcely less importance is the necessity to overcome the jassid pest, but this problem seems to be well in hand, although it may be several years before sufficient jassid-resistant cotton seed is available. The cotton pests of minor importance do not need urgent attention, but they should be studied more in detail as time permits.

Serious foreign cotton pests, especially the pink bollworm, should be diligently watched for, and we must be ready should any appear within our borders. In my opinion, cotton insect control as a whole is not entirely an entomological matter; it also concerns agronomic practices and plant-selection studies, and is also influenced to a great extent by climatic conditions. It should be our aim to control cotton pests as much as is possible by cultural practices, and to grow cotton plants that are more retentive of their bolls and at the same time resistant to the jassid and to plant diseases. However, it is possible that these more desirable methods of control will have to be supplemented, perhaps permanently, by artificial methods of control, such as dusting or spraying, for certain pests during some seasons.

Whether or not ratooning is profitable is still a debatable question, but in my opinion this practice is best left to be decided without government interference, and I think experience will in time teach cotton growers that it is advisable to plant every year.

MIXED FARMING.

Until definite and effective remedies can be found for the more serious cotton pests, I think it advisable, especially in those parts of the Union where the bollworms and the jassid are serious pests, that cotton be not depended upon as the sole source of crop-income. I strongly urge that serious consideration be given to the possibility of growing other crops as well as cotton, and also, where this is possible, that more attention be given to mixed farming, i.e. live stock and field crops. Diversification of crops is a very important factor in successful farming, as it acts as a safeguard if one crop fails, and it may also assist considerably in the control of insect pests. It is also evident that certain areas of the Union are better suited to the growing of cotton than others, and these areas must be found if losses are to be reduced to a minimum.

Eggs, Cheese, and Honey for United Kingdom.

The Merchandise Marks (Imported Agricultural Produce) Bill which was introduced in the House of Commons on the 22nd July last, provides that all eggs, cheese, and honey imported into the United Kingdom must be conspicuously and indelibly marked with an indication of origin. The expression "Indication of Origin" means either a statement as to the country in which the commodities were produced or a statement in the case of goods produced in any part of the British Empire that the goods are Empire produce.

APPLE FRUIT-SPOT.

Phoma pomi (Passer).

By C. J. HOPKINS, B.Sc., Mycologist, Division of Botany.

DURING April of this year apples were sent in from a Transvaal orchard bearing brown, spot-like lesions not unlike those produced by hail. The pathological nature of the trouble was shown, however, by the isolation of a fungus which conformed in its cultural and microscopical characters to *Phoma pomi* (Passer), to be the cause of the American apple fruit-spot disease. Infected apples, kept in a moist chamber, developed after a few weeks the black flecking of the spots, which is quite a characteristic of the disease, and is due to the development of the fruiting bodies of the fungus.

OCCURRENCE.

The Phoma fruit-spot occurs very commonly in certain of the states of America, notably in New Hampshire, whence the name New Hampshire fruit-spot. It is known to occur very generally, however, along the Atlantic coast from Maine to North Carolina, and also in states further west and in Canada.

In South Africa definite proof of the occurrence of this disease comes so far only from one locality in the Transvaal, though there is every reason to believe, from certain market specimens observed, that it exists in other parts of the country.

HOST VARIETIES.

The disease has been identified on the following varieties of apples, all from the same orchards:—Ohenimuri, Rome Beauty, Jonathan, White Winter Pearmain, Lord Wolseley. In America, however, the disease is found on almost every variety of apple, Baldwins and Tolman Sweets being especially susceptible. It has also been shown that the fungus causing apple fruit-spot is identical with that causing a fruit blotch in quinces.

CAUSAL FUNGUS.

The fungus was originally named *Cylindrosporium pomi* by Brooks. A Phoma stage has since been found and the name changed to *Phoma pomi*, Passer.

DESCRIPTION OF THE DISEASE.

The lesions in Phoma fruit-spot are quite characteristic, though there may be some difficulty in distinguishing them from lesions caused by certain physiological diseases, notably bitter-pit, a disease due to a fluctuating water supply. The difference is at once apparent, however, on cutting open a diseased apple. While in Phoma fruit-spot the diseased portion extends only a fraction of an inch below the

skin, in bitter-pit affected areas occur right through the flesh of the apple.

The spots start from the lenticels as small darkened areas, the intensity of colouring being always greater than that of the surrounding tissue; a deeper red on red portions of the fruit and a darker green

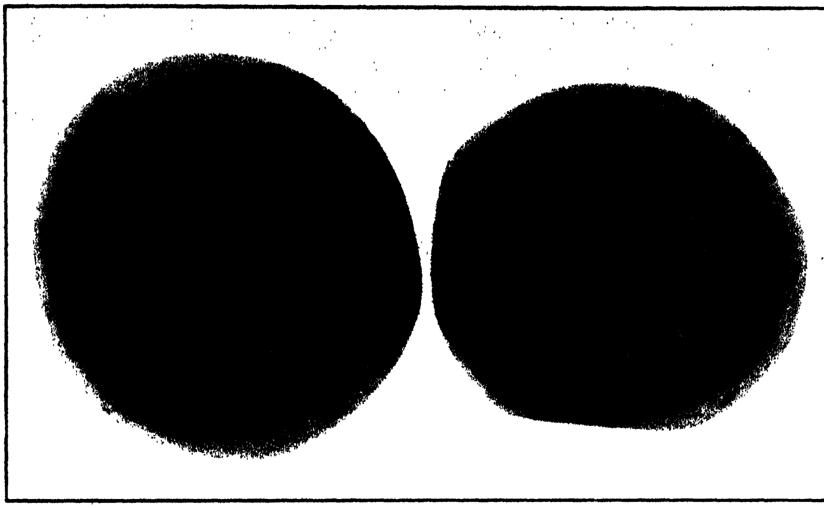


FIG. 1.—Typical fruit-spot on Ohenimuri apples.

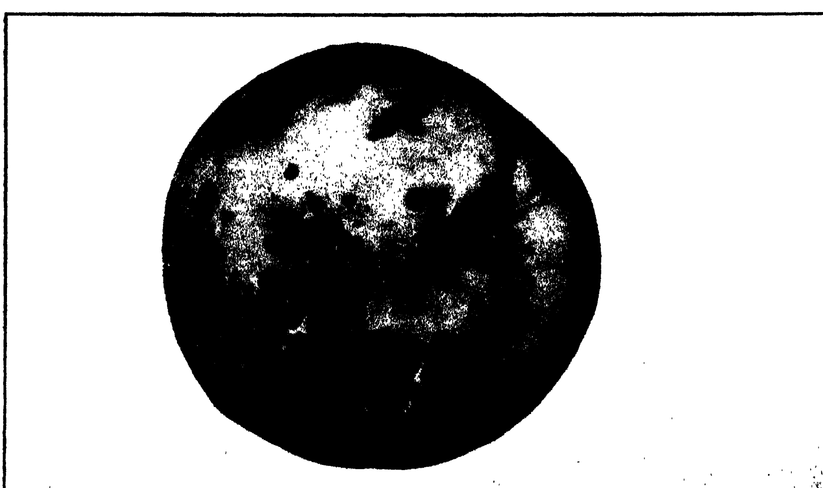
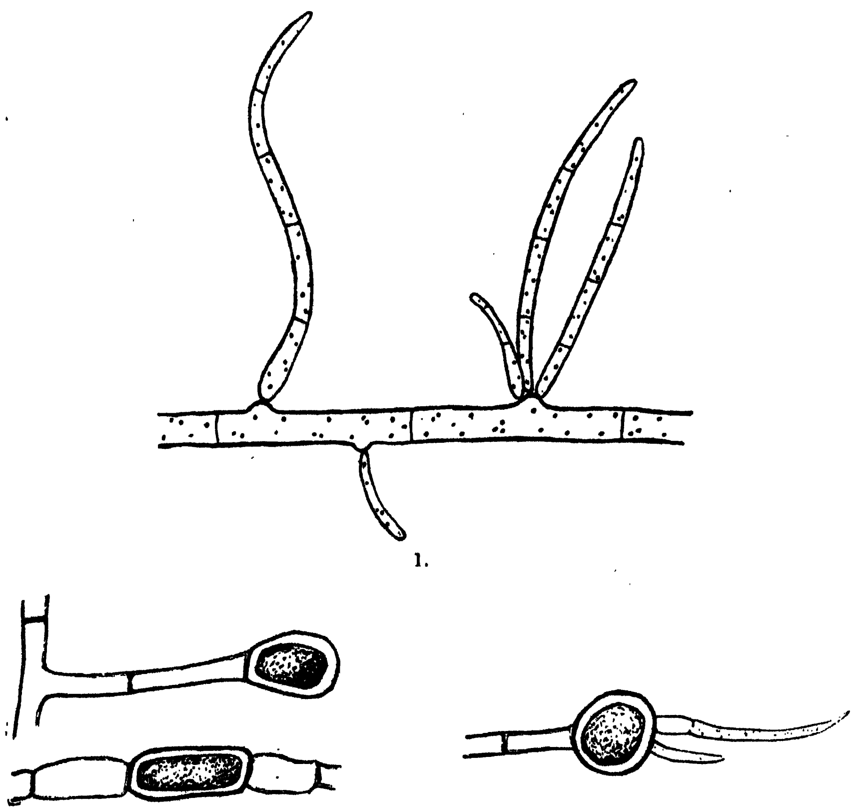


FIG. 2.—The development of rot-like areas on an apple kept in ordinary storage.

on green portions. On some yellow varieties the spots are first reddish in colour, but later enlarge and turn brown. In early stages the spots are usually not sunken, another point of difference from the spots of bitter-pit, but, as the infection progresses, they grow large, become dark red, brown, or even blackish in colour, and

slightly sunken. In advanced stages of the disease black specking occurs, chiefly towards the centre of the spots. These are caused by the development of the fruiting pustules or pycnidia of the fungus. The spots seem to be more abundant towards the blossom end of the fruit, this probably being due to the larger number of lenticels at that end.

The tissue is affected to the depth of a few cells only at first, but in later stages the depth may be increased. On very ripe fruit, brown, rot-like areas usually develop from the spots as centres. This was especially noticeable in infected Rome Beauties. In diseased



1.

2. 3.

FIG. 3.—(1) Formation of cylindrospores in cultures ; (2) Chlamydospores from a fruit-spot ; (3) Chlamydospore germinating in culture.

tissue the cells near the surface are smaller and thicker walled, have a large starch content, and denser protoplasm. The cells of the fruit pulp seem less able to resist the attacks of the fungus, several of them collapsing and producing pocket-like areas, which are usually packed with the mycelium of the fungus.

DEVELOPMENT IN STORAGE.

Infected apples were kept for some time in an ice-chamber as well as in ordinary storage. From observations made some weeks

later, it seems that the development of the disease is arrested indefinitely in cold storage, whereas in ordinary storage the spots develop slowly, and the disease undoubtedly leads to rot.

Perhaps the most important result of the disease is its effect on the appearance of the fruit and the consequent lowering in grade. Apples of otherwise first grade qualities are completely disfigured by the spotting caused by this disease. In young stages the flesh of the fruit is perfectly sound and the taste normal, but this disfiguring effect lowers the marketable value of the fruit appreciably.

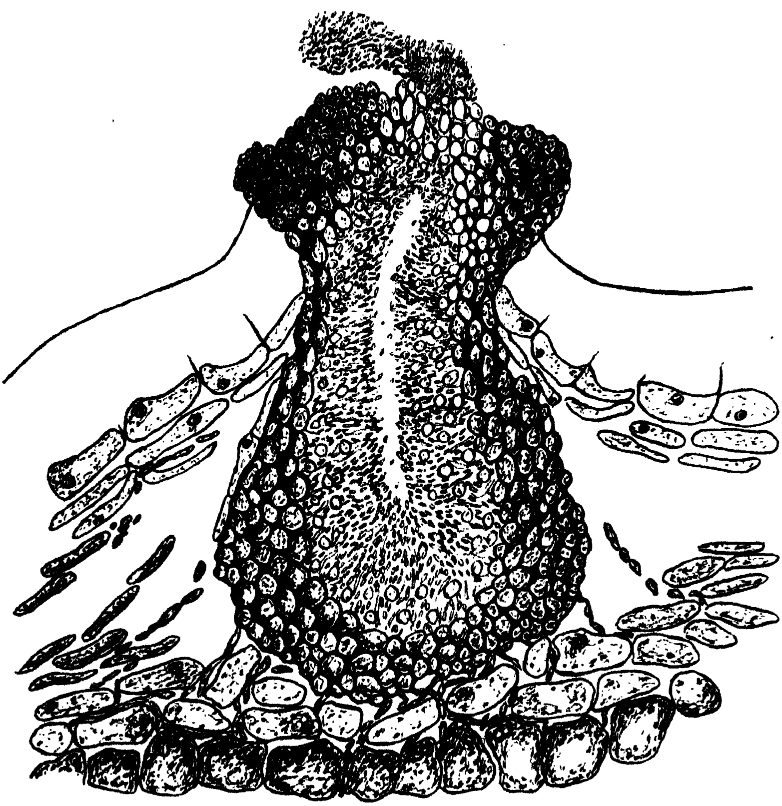


FIG. 4.—A mature pycnidium of *Phoma pomi* from an apple-spot, showing spores escaping in a mass at the opening.

DESCRIPTION OF THE FUNGUS.

The vegetative part of the fungus or mycelium can be readily made out in the pocket-like areas of the diseased tissue mentioned above. The mycelium is coarse and divided by cross walls, but finer threads or hyphae extend from them into the surrounding tissue. Unlike the coarser mycelium, these hyphae are colourless and translucent, and show no cross walls. Thick-walled spores, known as chlamydospores, are not uncommon on the coarser hyphae. They are probably responsible for carrying the disease over the winter.

In late stages of the disease numerous minute black specks appear in the spots, sometimes arranged in the form of a circle. These are caused by the development of the pycnidia or fruiting bodies of the fungus, and they burst through the surface, setting free myriads of minute spores, which are carried by the wind or insects to infect fresh fruit.

Another type of spore that is found in the host tissue and is rather common in cultures of the fungus on certain media is known as a cylindrospore. These spores are long and slender, consisting of one to a few cells, and they develop from small knob-like projections on the sides of the hyphae.

CONTROL MEASURES.

Fruit-spot can be controlled by suitable spraying. As the fungus attacks the fruit only when nearing maturity, mid-summer spraying is as efficacious, if not more certain, than early spraying. If the trees have already been sprayed for scab, further spraying for fruit-spot will not be necessary. Otherwise, the trees should be sprayed in late December or early January. Both bordeaux and lime-sulphur have given satisfactory results, but lime-sulphur is preferable, as being less liable to damage the fruit. If bordeaux is used, the following solution is most satisfactory for use in the apple orchard:—

Copper sulphate	3 lb.
Quick-lime	3 lb.
Water	50 gals.

Egg Export Season, 1925.

New regulations regarding the export of eggs oversea were issued on the 26th August last in Government Notice No. 1470, and every exporter should make himself fully acquainted with them. No consignment of eggs will be allowed to be exported which, in the opinion of the Government Inspector, is unfit through lack of quality, improper grading, or faulty packing. A Board of Appeal has, however, been appointed at Capetown, and any person who is dissatisfied with any decision or action of an inspector may place the matter before the Board on making a deposit of £5 for each consignment of eggs in respect of which an appeal is made. The Board will investigate the complaint, and its decision will be final. In the event of the consignor's contention being upheld, the deposit made by him will be refunded to him; otherwise he will forfeit it.

INQUIRIES AND REPLIES.

SELECTED LETTERS FROM FARMERS.

[Hereunder are a number of recent letters replied to by the various Divisions and Schools of Agriculture concerned. They are selected for publication as being of interest to farmers generally in the localities affected. In each case the area only from which the inquiry emanates is given; as the replies must necessarily be curtailed, they will indicate, when required, literature from which further information may be had. All departmental bulletins quoted are obtainable on application to the Editor.]

Manufacture of Bricks.

Hoopstad, O.F.S.—I contemplate the manufacture of bricks on my farm, for use in cow-stable construction. How should the necessary moulds be constructed?

Glen School of Agriculture replies: The measurements of an ordinary brick are 9 in. by 4⅜ in. by 3 in., but, to make allowance for contraction, the mould may be 9½ in. by 4⅝ in. by 3⅛ in.. The mould should be made to accommodate three bricks at one time and may be constructed as follows:—All timber should be ⅞ inch thick. Cut two pieces for the sides of the mould 3 feet long and 3⅛ inches wide, the ends being finished in a half circle, thus tending to prevent the splitting of the wood which is liable to occur, due to the tapping of the mould which is necessary to facilitate the removal of the "green" bricks from the mould. The bottom consists of one piece 2 ft. 10 in. long by 4⅜ in. wide, that is, ¼ in. narrower than the inside of the mould, the reason for this being to leave a space of ⅛ in. between the edges of the bottom and the sides of the mould, which spaces permit of the ready escape of air when mould is being filled with brick-earth. The divisions, four in number, consist of pieces 4⅞ in. long by 3⅛ in. wide, the length being ¼ in. wider than the inside width of completed mould. The ends of the divisions are inserted an eighth of an inch into the wood forming the sides of the mould, the mould being thereby considerably strengthened. The timbers necessary to form the frog in the brick may be 4½ in. by 1½ in. by ⅝ in., shaped as desired and nailed to bottom of mould. The mould should be strongly screwed together by screw-nails through the sides and the bottom into the divisions, six nails into each division, since the mould is subjected to fairly rough usage. The top of the mould is protected by nailing strips of hoop-iron thereon, thus preventing wear taking place on top of mould, due to the excess of brick-earth being scraped off each time mould is filled. To allow bricks to leave mould very cleanly and easily, the inside of the mould may be lined with sheet zinc or galvanized iron.

Blowing Down and Washing Out the Boiler.

Kroonstad, O.F.S.—Should a steam boiler be blown out entirely? How should a boiler be washed out?

The Glen School of Agriculture replies: It is bad policy to blow out a boiler entirely. When the boiler is emptied in this manner, it is very hot, and during cooling injury is caused by the unequal contraction of the various parts. The tubes are very much thinner than the tube-plates and shell, consequently they cool much quicker, and in so doing severe strains are set up throughout the boiler. These strains cause leakages to take place at the various joints, and particularly between the tube-plates and the tube ends.

To wash out a boiler, it should be allowed to cool down until no pressure exists, after which the blow-down valve or cock is opened and the water allowed to run out. Remove the doors immediately and brush or scrape off the deposit on the internal parts. The cleaning process ought to be carried out as rapidly as possible, because the scale tends to harden when exposed to the atmosphere. After the internal parts have been thoroughly cleaned, use water, under pressure, from a hose to wash out the dirt.

A boiler having a scale deposit one-sixteenth of an inch in thickness will require about 10 per cent. more fuel than is necessary when the boiler is clean. It is advisable, therefore, from an economical point of view, to keep the boiler as clean as possible.

Scale is a non-conductor of heat, and, if present, prevents the rapid transfer of heat which is necessary from one side of the heating surfaces to the other; thus the heat is retained in the heating surfaces, and softens the metal, instead of passing through to the water rapidly. If the metal is overheated, it becomes soft and is unable to withstand the pressure, and buckling may result. Never blow down a boiler when the pressure exceeds 15 lb. per square inch.

Killing Trees.

Greenwood Park.—Could you give me a way of killing a wild fig tree by injection. There is one on my ground, the roots of which threaten my house. I want to kill off roots as well as trunk.

Cedara School of Agriculture replies: The most effective method for killing living trees without removing them is a combination of *ring barking* and arsenical poisoning. This method is to make a series of downward cuts with an axe, completely girdling the tree as near the ground as possible. None of the chipped wood should be removed, as this forms a kind of basin to hold the liquid. A 10 per cent. solution of arsenite of soda should then be poured into the frill of cuts on the stem. This method is most effective in the dormant season.

Barley, Lucerne, and Peas.

Kokstad, East Griqualand.—Please advise me on the following matters:—

1. For an early crop of "Cape" barley as pig feed, the ground is already ploughed and cross-ploughed, and I have the fertilizer. I can also irrigate. How much fertilizer must I use to an acre of ground?

2. Ground ploughed can be irrigated, and I have lime on hand; also fertilizer. I wish to sow lucerne for pig feed. How much lime to the acre? How much fertilizer? Must lime be ploughed in? When is best time to sow lucerne?

3. I wish to try a crop of maple peas. Ground can be irrigated. When is best time to sow and what fertilizing?

Cedara School of Agriculture replies:—

1. 150 lb. per acre.

2. 1,000 lb. ground limestone.
150 lb. fertilizer.

The lime should be spread over the ploughed surface and harrowed in at least six weeks before sowing the seed. February is a good month for sowing lucerne seed.

3. February to March for winter crop; October to December for summer crop. For lime and fertilizer treatment see answer to No. 2.

Fowls in Orchard.

Muden, Natal.—I have an orchard of sixteen acres of six-year-old citrus trees under irrigation. I propose running fowls in it on the colony system. How far will spraying of the trees affect the fowls? The sprays used are lime-sulphur, bordeaux, resin wash (resin, fish oil, and caustic soda), and red oil (Gargoyle oil).

How must I deal with the fowls when the trees are fumigated with cyanide? For a time the ground round the trees will doubtless be highly poisonous to fowls, and they might have to be confined to their houses. Fumigation only takes place at infrequent intervals, and to a certain extent a portion of the orchard can be done at a time. Perhaps digging round the trees after fumigation would make the orchard safe for the fowls.

Cedara School of Agriculture replies: None of the sprays you mention (lime-sulphur, bordeaux, resin, oil, etc.) will subject fowls to the slightest danger. You might add fruit-fly bait (arsenate of lead) to the list as well, unless it is applied in very excessive quantity. If your orchard is entirely citrus, there is no chance of poisoning fowls, since arsenicals (except fruit-fly bait) cannot be used on citrus. Even when apples are sprayed with arsenate of lead there is very little danger to fowls.

The only materials remaining poisoned after fumigation with cyanide are those containing much moisture. The soil would be poisonous for a short time if wet, but if the surface were dry there would be no danger. Rotting fruit might dissolve and hold enough of the gas to kill fowls which eat it. If the orchard is clean of decaying fruit and the ground is dry, there should be practically no danger. However, it would be well to arrange facilities for shutting up fowls for short periods.

Bone and Meat Meal for Pigs.

Kokstad.—(1) I have here a supply of bonemeal to feed to growing pigs being prepared as baconers; (2) also bone and meat meal for small pigs. How must I mix this?

Cedara School of Agriculture replies:—

(1) Mix 2 lb. into every 100 lb. of grain seed.

(2) Use 10 lb. of bone and meat meal to every 90 lb. of other grain. The bone and meat meal manufactured in this country contains an unduly high percentage of bone. You will probably obtain better results from a mixture of equal parts of bone and meat meal and bloodmeal than from the bone and meat meal alone.

A Wool-sorting Table.

Willowmore.—Could you please give me the dimensions of a wool-sorting table?

Grootfontein School of Agriculture replies: Wool-sorting tables should be 8 ft. long by 5 ft. wide and 2 ft. 10 in. high. Rollers should be 1 in. apart and 1¼ in. in diameter.

Blue-Tongue Vaccine.

The price of this vaccine, which is only supplied in bottles containing twelve doses and multiples of twelve, has been reduced to 6d. for twelve doses. Owing to a printing error in the sheet "Advice to Farmers" issued with the Census form this year, it was shown as 5s. 6d. Blue-tongue affects sheep, and in some districts assumes the character of an epidemic. The season for the disease is now at hand, and farmers should avail themselves of the safeguard provided by the vaccine, which costs but ½d. per dose. Dosing should take place at once. There are certain restrictions when using the vaccine for imported sheep; the directions issued with the vaccine detail these.

NOTES FROM THE "GAZETTE."

Attention is drawn to the following matters of interest which appeared in the *Union Government Gazette*:—

(Abbreviations: "Proc."-Proclamation. "G.N."-Government Notice.)

Gazette. No.	*Date.*	*Items.*
1498	14/8/25	*Dipping of Cattle.*—The compulsory disinfection and dipping of all cattle has been ordered as follows: Every five days in the five-day dipping-fluid for certain defined areas in the Umvoti District, Natal; also for the Takazi Cattle Tank Area, Kentani District, Transkeian Territories. (G.N. No. 1374.)
1498	14/8/25	*Infected Areas.*—Certain areas in the Districts of Umvoti, Natal, and Kentani, Transkei, have been declared infected in consequence of an outbreak of East Coast fever. (G.N. No. 1375.)
1500	21/8/25	*Co-operative Societies.*—Important particulars affecting co-operative societies or companies registered under the Companies Law of the Union, and associations which are carrying on operations as a co-operative society or company but not registered under any law, are published in G.N. No. 1401. The registration of the above-mentioned societies and companies is provided for in G.N. No. 1433 of 19th August, 1925.
1501	28/8/25	*Fencing.*—Contributions towards the cost of (*a*) converting dividing fences into vermin-proof fences and (*b*) erecting vermin-proof fences as dividing fences have been declared obligatory in Ward No. 6, Pramberg, District Victoria East, Cape. (Proc. No. 194.)
1503	4/9/25	Contributions towards the cost of dividing fences have been declared obligatory in Ward No. III (Venter), District Philipstown, Cape. (Proc. No. 203.)
1504	11/9/25	A levy of 5s. (five shillings) has been imposed on every adult male inhabitant of Mbiba's Location, in the District of Kingwilliamstown, for the purpose of obtaining repayment of the advance which has been made by the Government for the erection of a dividing fence between the said location and the farm Kelly. (Proc. No. 218.)
1498 1500 1503 1504	14/8/25 21/8/25 4/9/25 11/9/25	*Crown Lands for Disposal.*—Certain Crown lands in the Districts of Prince Albert and Calvinia will be offered for sale by public auction on the 10th of October, 1925. (G.N. No. 1361.)
1503 1504	4/9/11 11/9/25	The farm Zuurkloof, in extent approximately 805 morgen, situate in the Klein Winterhoek Field Cornetcy, District Uitenhage, will be offered for sale by public auction on the 14th November, 1925. (G.N. No. 1502.) (Diagrams and conditions of sale of the above farms may be seen at the Department of Lands, Pretoria, and at the offices of the respective magistrates.) A piece of Crown land, situate in the District of Mount Currie, will be offered for lease, by public auction, at Kokstad on the 10th October, 1925. (G.N. No. 1501.)
1504	11/9/25	Certain erven, situate in the township of Ventersdorp, Transvaal, will be offered for sale by public auction on the 17th October, 1925, at 11 a.m. (G.N. No. 1543.) Tenders are invited by the Department of Lands for the purchase of the farm Tweeloop No. 178, Wolmaransstad District, in extent approximately 51 morgen. Tenders should be addressed to the Secretary for Lands, Union Buildings, Pretoria. (G.N. No. 1544.) A certain portion of the farm Hartebeestpoort No. 498, District Pretoria, in extent approximately 57 morgen, is available for lease. A plan of the land may be seen at the Office of the Secretary for Lands, Union Buildings, Pretoria. (G.N. No. 1550.)

STAFF: APPOINTMENTS, CHANGES, ETC.

1/4/24 *F. J. McArthur*, Poultry Assistant at Elsenburg, appointed Egg Inspector and Itinerary Poultry Officer.

1/7/24 *A. J. Smith*, Assistant to Entomologist, appointed Entomologist at Rustenburg.

21/7/24 *Miss H. Anderssen*, Household Science Officer, transferred to Transvaal Education Department.

27/7/25 *G. H. Hepburn*, appointed Entomologist.

31/7/25 *C. R. Wyche*, Housemaster, Grootfontein School of Agriculture, appointed Sheep and Wool Expert.

4/8/25 *C. D. B. Liebenberg*, Tobacco and Cotton Experiment Station, Rustenburg, appointed Botanist at Pretoria.

5/8/25 *M. van Niekerk*, Principal Clerk, Head Office, Pretoria, promoted Second Grade Chief Clerk, Veterinary Division.

9/8/25 *J. J. Jordaan*, Lecturer in Poultry at Glen, transferred as Technical Assistant to Division of Markets and Economics.

CITRUS CANKER ERADICATION.

INSPECTION WORK, AUGUST, 1925.

Farms Inspected—

Rustenburg District (Hex River Ward).—Buffelspoort No. 668, Kafferskraal No. 915, Roodekopjes No. 171, Swartkopjes No. 711, Donkerhoek No. 211, Buitenlust, Belle View, Boschdal No. 362, Klipfontein No. 538, Rietfontein No. 290, Weltevrede, Frank Farm, Alkington Fruit Farm, Rustenburg Town Lands.

Pretoria District (Crocodile River Ward).—De Kroon No. 420, Krokodil Drift No. 327.

Pretoria District (Aapies River Ward).—Wagon Drift, Klip Drift, Middel Kop.

Waterberg District (Nylstroom Ward).—Roodepoort No. 2148.

Fresh Infections.—Government Experimental Orchard; Buffelspoort No. 668, District Rustenburg.

Fresh Outbreaks.—Nil.

Total Number of Nursery Trees Inspected.—11,294.

Total Number of Trees Inspected.—145,070.

Total Number of Trees found Infected.—1.

Number of Inspectors Engaged.—14.

SHORTHORN HEIFER "GROOTFONTEIN MAUDIE." [*Photo Farmer's Weekly.*

Bred by the Grootfontein School of Agriculture, Middelburg, Cape.

Winner of the Fifty Guinea Cup presented by the Shorthorn Society of South Africa for the best Shorthorn on the Royal Agricultural Society's Show, Pietermaritzburg, June, 1925, to commemorate the visit of His Royal Highness, the Prince of Wales, to the Show.

Owner (right) Mr. W. E. Edwards (holding the Cup); Mr. R. M Fawcett, Judge of Dairy Shorthorns (centre); Mr. Cuthbert A. Pope, Judge of Beef Shorthorns (left).

JOURNAL OF THE DEPARTMENT OF AGRICULTURE.

VOL. XI. NOVEMBER, 1925. No. 5.

Published monthly in English and Afrikaans by the Department of Agriculture, Union of South Africa.

SUBSCRIPTION: Within the Union and South-West Africa, 5s. (otherwise 6s.) per annum, post free, payable in advance.

Applications, with subscriptions, to be sent to the Government Printer, Pretoria.

NOTES.

The Publication of a New Journal.

The next issue of the *Journal* will be devoted entirely to the publication of the Department's Annual Report for the year ended 30th June, 1925, which will give a comprehensive review of the Department's activities and of the progress of agriculture generally during that period. In the Publications section of the report reference will be made to the expansion of the Department's educational and extension work by means of printed matter and to a projected "popular" monthly journal to replace the present *Journal* which will, with certain modifications, be issued quarterly instead of monthly. The monthly *Journal* will contain concise, easily read articles, notes, etc., presented in an attractive manner, and furnish the class of literature that will appeal to farmers generally. It will include, for instance, summaries of all lengthy articles (which will be published in the quarterly *Journal*) giving just the information that the farmer wants and can put into practical application.

The Department is alive to the paramount need of bringing home its teachings to the farmer, and to do this it depends chiefly on its printed publications. Experience shows that, broadly, there are three classes of readers: (*a*) the ordinary farmer who wants clear and concise matter; (*b*) the semi-technical reader and the non-technical man who studies agriculture; and (*c*) the purely technical reader. With its monthly and quarterly publications, supplemented by the issue of special bulletins, the Department will have the means of reaching all three classes. Thus the Department will not have failed in its duty of making known the results of its investigations, etc. It expects the farmer to do his share and make an effort to become acquainted with the advice and information made available to him.

The present *Journal*, that in due course will be issued quarterly, has served a valuable purpose. Since its commencement in April, 1920, it has published a wide range of sound, South African agricultural literature. It stands as a record of agricultural progress during

the past five years and makes known the result of considerable Departmental investigation and research during that period. Practically all the bulletins issued to-day by the Department and for which thousands of applications from farmers are received, have passed through the *Journal.* Of inestimable value to our own farmers, it is also in demand overseas. Indeed, its consistently high standard has shown the world the advanced stage of Government organization in agriculture. It has thus played no mean part in advertising our country, showing that our great industry of agriculture is guided by a body of highly trained workers who have made the land safe for agriculture and are eager to assist the farmer in making a success of his enterprise.

South African Irrigation Experience—Important Experiments at Grootfontein.

It is essential for the irrigation farmer to understand the several factors that govern the response of a crop to irrigation water, and the relationship between the soil and the water applied. This knowledge is too often acquired by the farmer at heavy cost. Experiments have been in operation at the Grootfontein School of Agriculture, Middelburg, Cape, for some time past with the object of obtaining such information under South African conditions. It will, however, be some years before any conclusions can be drawn from these experiments, and in the meantime irrigators will need to be guided by the experience of other countries. A most useful article in this connexion has been written by Dr. H. W. Turpin (who is in charge of the Experiments at Grootfontein referred to above). It is entitled "Irrigation, with Special Reference to the Economic Use of Water," and is published in this issue of the *Journal.* The object of the author is to deal with certain broad principles applicable under the most variable climatic conditions, emphasizing that heavy irrigations are not economical and are even injurious to the soil. "We do not wish," Dr. Turpin states, "to repeat the costly experience of irrigators of other countries and ruin our land through over-irrigation, and it is felt that once we appreciate the principles underlying scientific irrigation there should be no fear that we shall run the risk of spoiling our fertile irrigation lands."

The experiments, started at Grootfontein in 1922, will, it is expected, add greatly to our knowledge of irrigation under South African conditions.

The objects of the experiments are briefly:—

(*a*) To determine the most economical quantity of water for the main fodder and cereal crops grown in the arid and semi-arid areas.

(*b*) The effect of heavy irrigations on crop growth and soil conditions.

(*c*) The effect of variations in quantity of water on yield per acre and yield per unit of water.

(*d*) The effect of uniform irrigations throughout the season.

(*e*) The most suitable stages in the growth of crops at which to irrigate.

(*f*) The effect of one or more irrigations per season on the yield.

(g) The effect of gradually increasing the quantity of water from commencement of growth until the period of most active growth and then reducing the amount as maturity approaches.

Observations will also be made in connexion with the effect of different irrigations in crop, composition, etc.

In the experiment there are two hundred and sixty 1/80th-acre plots. The soil consists of the usual dark alluvial soil found so abundantly along the rivers of the Karroo. Since the plots were completed in May, 1922, three uniform crops have been grown to determine the variation in the different plots.

One hundred and forty plots have now been established to lucerne and for the first season will all receive uniform treatment in order to make a further test of the uniformity of the soil. The rest of the plots will be established to annual crops which will be used as a fourth uniformity crop.

At the end of this season the different irrigations for respective groups of plots will be commenced and the first results from properly laid-out irrigation plots in the Union will be obtained during the season 1926-27.

On account of the variation in climate and the impossibility of obtaining plots that are absolutely identical, it will be some years before data of any great value will be obtained. By the 1930-31 season it should be possible to publish a report of progress, and no doubt some very valuable data will then be available. It seems a long time to wait, but the farming community will no doubt appreciate the fact that the more carefully and scientifically such experiments are conducted, the greater the reliance that can be placed on the results.

Combating Blowflies: An Ingenious Trap.

The blowfly menace is receiving the close attention of the Department, and farmers have been warned of the great loss that would follow the spread of the pest. Prompt control measures in dealing with the trouble should avert this danger, and here the proper disposal of carcasses is of first importance, for the blowfly breeds readily in carrion—meat, indeed, being the natural food of the maggots of the blowflies.

Mr. Smit, the Entomologist at the Grootfontein School of Agriculture, has carefully investigated the position. Carcasses may be disposed of by burning, burying, or poisoning, but none of these methods has he found to be entirely satisfactory under our conditions. He has therefore invented a trap that seems to be eminently suitable for the purpose. Full details of this ingenious device are published in the present number of the *Journal*, and farmers are urged to introduce it on their farms. It is a comparatively simple contrivance and easily made. It effectively disposes of carcasses, and there is no immediate need to poison, burn, or bury them The trap, moreover, draws away flies from the live sheep and entices them to lay their eggs where these are ultimately destroyed as maggots.

The trap invented by Mr. Smit provides an admirable means of combating the pest and will prove a boon to farmers in the blowfly area.

DEPARTMENTAL ACTIVITIES.

(NOTE.—The work of the several Divisions and Schools of Agriculture covers a wide range of agricultural industry in the Union, and we give hereunder notes and observations from certain of them treating with matters of special interest coming under their purview month by month. The object of these notes, which are not concerned with general routine work, is to inform the farmer of such matters as are calculated to be of interest and helpful to him.—EDITOR.)

THE DIVISIONS.

ENTOMOLOGY.

Insect Pests.—The two peach aphides *Anuraphis persicae niger* and *Myzus persicae* have both been troublesome during September over a very wide area, complaints reaching the Division from various parts of the Transvaal, Orange Free State, and Transkei. The outbreaks are, however, more of a scattered than a general nature. The bagrada bug (*Bagrada hilaris*) has also been the subject of complaint but, apart from a sporadic outbreak in Griqualand West, was not commonly abundant. From Griqualand West two reports relate to mischief done to wheat. Injuries to young citrus fruit by the American bollworm have been reported from several sources and it would appear that these insects have been fairly prevalent on citrus in parts of the Rustenburg District.

Scavenger Bollworm of Cotton.—Probably owing to the more general interest being taken in cotton insects, a small pinkish caterpillar infesting the seed and lint of late-opening bolls has of late been brought rather frequently under notice. This is the larva of a small moth of the genus *Pyroderces*, but, owing to its habits and somewhat superficial resemblance to the pink bollworm (*Platyedra gossypiella*) its discovery has given rise to a certain amount of alarm in various quarters. The insect has, however, been known for some time past, the first specimen coming from Swaziland in 1920. The specimens submitted this season were recognized as *Pyroderces* from the larval characters, and this determination has since been confirmed by Dr. A. J. T. Janse, who is a world authority upon South African Heterocera and who has examined the moths reared from the larvae. This insect invariably puts in its appearance late in the season and, as it has only been found in the debris and tracks of other bollworms and does not seem to be responsible for any primary damage, it is regarded as a scavenger where cotton bolls are concerned. The specific determination of this *Pyroderces* is not yet fully decided although it is regarded, provisionally, as *P. simplex*.

New Insecticides.—It is our intention to try out experimentally several new and promising insecticides. These experiments will be carried out in co-operation with Kynochs, Ltd., who are also taking an active interest in cotton insect control. Among these insecticides are sodium fluosilicate and mustard gas absorbed into powdered charcoal.

Locust Studies.—Dr. J. T. Potgieter was engaged practically throughout the whole of September upon field studies of locust egg parasites in the Districts of Laingsburg, Beaufort West, Middelburg, and Kimberley. Apart from the collection of other valuable data, he collected sufficient field evidence, subsequently confirmed by experiment, to show that the maggots of the dotted locust fly (*Wohlfahrtia euvittata*) are not only parasitic upon voetgangers and adult locusts but also live upon locust eggs. Whilst these maggots contribute to the destruction of many locust eggs, in some regions to as much as between 10 and 15 per cent., in other places the destruction of the eggs is negligible although the fly is present. Similar observations on the destruction of eggs by the maggot of this fly have been communicated by locust officers showing that it is taking place at scattered points over a wide area.

About the middle of the month Dr. C. W. Mally left Pretoria with his mobile field laboratory for the purpose of examining the locust situation at Kuruman and beyond.

Jassids on Wheat, Etc.—During September Dr. T. J. Naude visited Barberton District in connexion with cotton jassid and tobacco slug. Mamagalieskraal Settlements near Brits were also visited in connexion with jassid attack on wheat. Several species of jassid were found implicated in the latter case; they are all common grass-infesting kinds and their concentration on wheat seemed to have been brought about accidentally by unusual circumstances.

Apiculture.—Dr. A. E. Lundie accompanied the demonstration train on its seventh tour (N.E. Transvaal, 17th August to 9th September) and gave lectures on apiculture at eighteen centres. Great interest was shown in the lectures and in the exhibit illustrating modern beekeeping appliances and the biology of the honey-bee. The progress of this officer's work is indicated by the fact that several firms have reported a considerable increase in their sales of beekeeping equipment since the Department undertook a more extensive teaching of modern beekeeping methods.

FIELD AND ANIMAL HUSBANDRY.

Sun Scald Experiments with Pigs.—Experiments to test the susceptibility of various types of pigs to sun scald are now being carried out at the Schools of Agriculture. During last summer observations were made at Cedara, Potchefstroom, Glen, and Grootfontein, but owing to the unusually cool season experienced the results obtained were of little value. The experiments are being continued this summer at all the Schools and it is hoped that definite information will be available before long. The thanks of the Department are due to the Estcourt Farmers' Co-operative Bacon Factory in Natal for generously supplying the necessary stock for the experiment.

THE SCHOOLS OF AGRICULTURE AND EXPERIMENT STATIONS.

POTCHEFSTROOM, TRANSVAAL.

Storage of Maize: Small Silos for the Farmer.—There is a demand for information on the subject of grain silos now that the elevator system is in action, as farmers desire to use sacks as little as possible.

To hold 1,000 bags of mealies (in bulk), allowing 4 cubic feet to the bag, a capacity of 4,000 cubic feet will be required—say, a building 28 feet long by 16 feet wide by 9 feet high. Much better would be a round silo that can be made air-tight, with dimensions 16 feet diameter inside by 20 feet high. Such a silo would require to have reinforcement about 25 per cent. stronger than in the case of a silo for storing ensilage. Since it is to close air-tight, a roof of reinforced concrete would probably be the most suitable with a manhole to close air-tight (in it) for filling. For emptying, a door at the foot would be required, also to close air-tight. Since the silo should not be damp, it would be well to build it entirely above ground and insulate it from the latter by means of an effective damp-course. The maize, when put into the silo, should contan not more than 12½ per cent. of moisture. The building of such a grain silo, however, requires skilled labour, hence the following alternative might be adopted:—

A small silo of internal dimensions 10 feet diameter by 10 feet high has a capacity of 785 cubic feet. Build five of these. They might be built of hard, good-quality bricks, built soaking wet in cement mortar and laid to form a 4½-inch thick wall to an internal diameter of 10 feet. This should then be wound round on the outside with strong, plain fencing wire, coiled so that there is one wire to each course of bricks. The 4½-inch brick wall and its circumscribing helix of wire are then plastered with good cement plaster. If this is well done with the bricks laid wet and the wall plastered both outside and inside while wet, a very strong wall should result, which, if it broke, would fracture through mortar joints and the bricks themselves indiscriminately. A door, for emptying through, would be left in the wall near the bottom.

The floor also could be of bricks. It, as well as the rest of the silo, should be insulated from the ground by an efficient damp-course. The silo should be entirely above ground. Where the silo is to be, a layer of hard core, consisting of stones about the size of a quarter of a brick, should be put down and well rammed. The hard core may be finished off to a smooth top by means of sand. On top of this put down a damp-course of asphaltic felt or rubberoid, all over, below where the floor and walls are to be. Where different pieces of the asphaltic felt adjoin they should have a mutual overlap of at least 4 inches. These overlaps should be well gummed together by means of tar. Then give the whole damp-course a coat of tar on top and sprinkle with sand. On top of this the bricks for the floor are laid on edge, being bedded down into a layer of cement mortar on top of the damp-course, and being grouted in with cement mortar run in between the bricks.

The above precautions may appear excessive, but they are really required in order that the mealies will not become damp in the

silo, into which they are filled with a moisture-content of less than 12½ per cent., as already mentioned.

The roof would be of cement concrete. It might be practically flat with a slight slope (on its upper surface) from a high point in the middle to the eaves. It could be reinforced by laying tramway rails across the top of the walls—say three, spaced so as to divide the span into four equal parts, each about 2 feet 6 inches wide. The rails might be held in position by fencing wires so that they will not be displaced while the concrete is being deposited around them. These wires are also cross-reinforcement. They should be spaced about one foot apart and tied to the rails with binding wire where they cross the latter.

In the roof a manhole should be left for filling the silo with grain. This manhole can be closed by a wooden door bolted in place, and, with felt between the door and the concrete against which it rests, arranged to make the door air-tight when closed.

Near the bottom of the silo there should be an emptying opening and chute, the latter formed, say, in cement concrete. It is suggested that the opening might be 3 inches wide vertically and 6 inches long horizontally. This size of opening would interfere but little with the spacing of the reinforcing wire just there. The opening could be closed by brick and lime mortar, or in some way that will give air-tightness and yet allow of easy breaking out when the silo is to be emptied. If desired, a more elaborate arrangement of course could be fitted.

These small silos present the following advantages to the farmer:—

(1) They can be built without the special skill and experience required to build one large reinforced concrete silo.

(2) No moulds are required, only centering, or planking supported by poles from below, on which the roof is laid, and which is not removed until the roof has become strong enough to support its own weight without fear of cracking. This would be in about thirty days.

(3) These small silos are easier to clean out, should it be necessary to do so to remove insects, eggs, webbing, etc. Cleaning should rarely be necessary, however, if the silo closes quite air-tight.

Handling the Fruit Crop.—From now onwards fruit growers will be busy, and every opportunity should be taken of getting together the requisite number of boxes so that nothing will delay the dispatch of the fruit when harvested.

Presuming the grower knows the correct stage to pick the fruit (see November, 1924, *Journal*, page 381), it is essential that suitable equipment be provided to minimize bruising, etc. Light three-legged ladders are necessary to reach the highest fruit without damaging the trees; also lug-boxes, picking buckets or bags, and a light wagon to expedite the removal of fruit to the packing-shed. Frequent handling of picked fruit must be avoided, nor must it be carelessly poured from picking-bags into boxes, as each change results in some damage being done.

By rigid grading and attractive packing, whether for local or export markets, growers will be doing their share towards the selling of the fruit at remunerative prices.

Care of Young Fruit Trees.—Trees planted out during the past winter should now be making good headway. To obtain sturdy, well-balanced trees, see that at least three well-spaced growths develop around the stem. Where only one or two start, pinch out the point of the strongest after it has grown 15 to 18 inches and so put sap pressure on the buds lower down; if a V notch is made above a bud from which growth is desired the result is more quickly obtained. All superfluous growths should be removed, especially suckers which grow up from the stocks. Keep the soil around the trees open by having it forked occasionally; this aerates the soil and stimulates growth.

Thinning Fruit.—Attention should be given to the thinning out of apple and pear clusters if size, quality, and flavour are desired. Both these fruits are produced in clusters of five, six, and often eight: thinning should commence about three weeks after the crop has set, reducing each cluster to three or two respectively. Begin by twisting out the centre fruit, then remove any others necessary for good development. If thining is left until the fruits begin to push one another off, those remaining will not have a firm hold on the spur, and great loss will result. Thinning is easier when the fruit is small and green; it relieves the strain upon bearing-wood, conserves vitality, and tends towards the production of regular crops.

Cultivation.—Systematic cultivation must be practised if the trees are to derive the full benefit of the growing season. Cultivated land not only retains its moisture, but is capable of absorbing more without water-logging. Cultivation systematically carried on modifies the soil structure, controls the growth of weeds, disposes of coarse rubbish by turning it under the ground, and checks the rise of noxious soluble salts to the surface.

Summer Thinning of Growths.—Where trees, particularly stone fruits, are not carrying heavy crops owing to adverse climatic conditions, there is a tendency to develop large quantities of new wood. Where undue crowding occurs, thinning of this new growth should be done so that the buds on the growths retained may be strengthened and developed. If left to grow unheeded, weak unproductive growths will be the result and an increased amount of work will be necessary when pruning next winter.

Baiting for Fruit-flies.—Although the early varieties of peach, which will be ripening in the Transvaal shortly, are not severely attacked by the fruit-fly, growers are reminded of the following methods of control to adopt against this pest, viz.:—

1. *Baiting.*—The foliage of the peach is susceptible to the effects of arsenical sprays, and it is emphasized that the baiting treatment consists of lightly sprinkling the foliage and not spraying it as for codling-moth. Fruit-flies deposit their eggs under the skin of ripening fruit. These eggs give rise to the well-known footless maggots. The adult flies also feed on any juices available from damaged fruit. Therefore a bait is supplied consisting of arsenate of lead mixed in a sweetened solution according to the following receipe:—Arsenate of lead (50 per cent. paste), 3 oz.; arsenate of lead (powder), 1½ oz.; sugar (cheapest), 2½ lb.; treacle (unrefined), ½ gallon; water, 4 gallons.

Arsenate of lead can be procured as a paste or as a powder. Powder is easier to store and keeps indefinitely. It should be of a reputable brand. It is mixed into a smooth paste, free from any lumps, with a small quantity of the water, and is then stirred into the remainder of the water, in which the sweetening agent has been dissolved. Arsenate of lead is not soluble in water and has to be kept in suspension by agitating the mixture frequently, or preferably continuously. It is advisable to make up the bait just before applying it, and only in such quantities as will be used within a day or two.

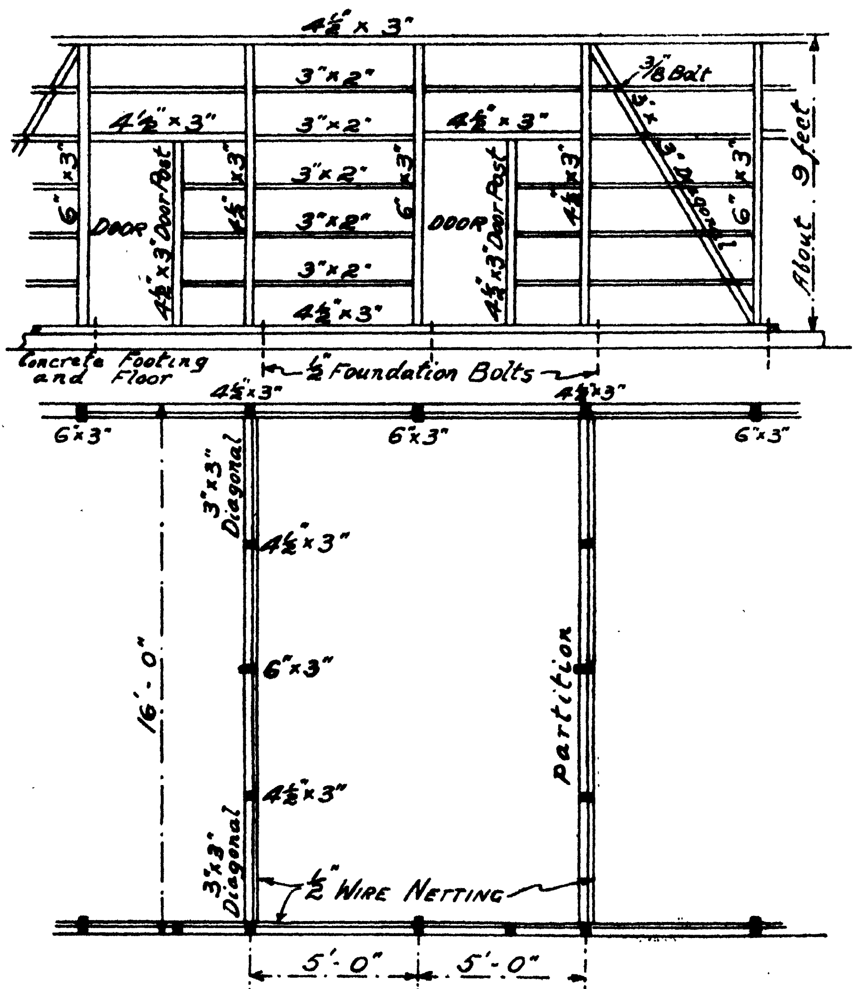
The bait is applied by means of an ordinary garden hand-syringe to which the finest nozzle "rose" has been fitted. One syringeful is ample for small trees, and only very large, badly kept trees require more than two. The operator walks round the tree at a distance of a few yards and applies the bait in a series of jerks, directing the liquid so that it falls on the foliage in the form of fine drops. Where it is possible the fruit should be avoided, as the object of the bait is to attract flies from the fruit. It is necessary to renew this bait at intervals of ten days, or more frequently if rain should wash away an application. As small holders or growers in town lots may be getting flies from neighbouring holdings, it is advisable to bait adjacent fences and hedges in addition to the trees. Such baitings are renewed in the same way as those applied to trees. As the eggs of the fly will not hatch in green fruit it is not necessary to bait until some six weeks before the first fruit is ripe, but the careful grower will see that baiting is applied well in time to catch flies from other yards. Baiting should be continued until three weeks after the last fruit has been removed from the trees.

2. *Picking up Fallen Fruit.*—Fruit infested with maggots ripens prematurely and usually falls to the ground. If left, the maggots on emerging will penetrate the soil to the depth of a few inches and there pupate. Later they will emerge as adult flies. To prevent this, fallen fruit should be gathered at least once daily and treated to destroy the maggots by submerging in water until fermentation destroys them or by burying or boiling. Burying the fruit is not of much use, as the adult flies are able to make their way through a couple of feet of soil. If the fruit is fed to poultry or pigs the quantities should be such that all is consumed very soon after feeding.

3. *Good Farm Practice.*—Careful cultivation of the soil tends to break up pupal cases and to expose pupae to weather influences, and to birds and other enemies of the flies. In small holdings, poultry could be kept in orchards with advantage. All fruit should be removed from trees at the end of the growing season.

Treatment of Sheep.—In most cases the sheep have by now been shorn and the ewes covered. The farmer must now make good the trying period through which the sheep have passed by giving them good grazing and kind treatment. Where keds are troublesome it will be advisable to dip the sheep after shearing while the wool is short. From the time of mating the farmer must treat the ewe well, as it is here that the standard of the future flock has its origin. Where possible, shade should be provided for recently shorn sheep, and attention should be given to any cuts in order to avoid maggots. Do not forget to provide a sufficiency of salt. This is an important and easy way for the farmer to keep his sheep in good health.

Store for Mealies on the Cob.—The accompanying drawing shows the construction of the framework for a store for mealies on the cob. It consists of a plan and an elevation of a part of the wall. The width is 16 feet, which is wide enough if there is to be sufficient ventilation through the mass of the mealies. The shed is divided into 10 feet lengths by partition walls, and may be further strengthened by a few double wires (horizontal) at these partitions,



STORE FOR MEALIES ON THE COB

judiciously placed and tightened by being twisted together. The dimensions of all timbers and their spacing are given on the drawing. The outer walls and also the partitions are covered with strong half-inch galvanized wire-netting. The roof trusses should be spaced not more than 5 feet apart, for a corrugated iron roof. That shown in Fig. 53 of the book "Farm Buildings in South Africa" (page 57), is suitable.

GLEN, ORANGE FREE STATE.

The Manufacture of Gervais Cheese.—Gervais cheese is manufactured from a mixture of sweet milk and cream in the proportion of two parts of milk to one of cream. The method is to add to two quarts of fresh milk one quart of cream. The cream must be fresh, consistency 25 to 30 per cent. butter-fat; this quantity should be sufficient to make twelve cheeses. Thoroughly mix the milk and cream together in an enamel bucket, and cool to between 60 and 65° F. Eight drops of rennet extract should be added to the mixture. Before adding the rennet it should be diluted with an equal quantity of clean water in order to promote thorough distribution. Stir in the rennet thoroughly during a period of from two to six minutes; cover the bucket with a cloth to prevent the entry of dust. When the curd has coagulated (thickened) it should be ladled out by means of a sterile ladle or spoon into well-scalded huckaback cloth. If the rennet is added at night the curd should be ready to ladle into cloths the next morning. Fix each cloth as you would a bag, taking care not to tie too close to the curd, or fat may be lost. Hang the cloths to drain, but not in a draught as when dealing with cream cheese (see September, 1925, issue of the *Journal*, page 204). Open the cloths when drainage slackens, and with a knife scrape down the hardened cream from the outsides into the softer cream in the centre. This process should be repeated every few hours until the cheese is in a pasty condition. At this stage the cheese must be salted to taste, fine butter salt being mixed thoroughly into the cheese.

The correct size of the Gervais mould should be 2½ inches deep by 2 inches in diameter. The mould should be lined with grease-proof paper, butter muslin, or blotting paper, into which the cheese is filled. When the mould is full fold over the wrapper and apply slight pressure by means of weight. The cheese may be eaten fresh. The flavour is considered superior to that of cream cheese.

Strict cleanliness must be observed in the production of milk and cream; the utensils must be well scalded before use. If this is not done the cheese may possess an "off flavour."

Fertilizers for Maize and Potatoes in the Orange Free State.—The results of last season's co-operative experiments carried out by Glen on farms in the eastern Orange Free State have proved convincingly (as far as this is possible during one season) that the *phosphate* deficiency in the soil is one of the main limiting factors in the production of maize and potatoes. On typical "maize bult" soil near Kestell Road, *phosphatic fertilizers* almost doubled the yield of maize as well as of potatoes. *Nitrogenous fertilizer* (tested in conjunction with phosphate and potash) gave a comparatively small increase for potatoes and a doubtful one for maize, while *potash* (tested in conjunction with phosphate and nitrogen) showed no evidence of benefit to either crop. Trials with kraal manure (on potatoes, with and without artificial fertilizer) seemed to confirm our views that those soils are also deficient in humus. A full account of the results of the experiments will appear in the *Journal* at a later date. It is intended to extend considerably these fertilizer experiments next season.

The Vegetable Garden in November.—This month young vegetable plants must be carefully watched, especially those in the seed beds, for insect pests, such as green-fly, Bagrada bug, cut-worms, etc. The seed beds should be inspected every week, and a very fine spray of paraffin emulsion, lime and sulphur, or tobacco extract should be given. Carefully hoe up between the rows and loosen the surface soil: this will disturb the cut-worm and, of course, greatly assist the plants. For the cut-worms set traps of small pieces of potato poisoned with strychnine.

Blindness in Cauliflower.—Often growers omit to look at their young cauliflower plants, with the result that many blind plants are put in. These are plants without a bud, and are quite easily recognized. This blindness is not due to insects, as many seedlings are so affected. These should be weeded out before or during planting.

CEDARA, NATAL.

Protection against Ants.—Ants frequently cause trouble to beekeepers by entering hives and stealing honey. There are probably various species that may do this under certain conditions. One of the standard methods for keeping out the intruders is to place the hive on four bricks which have been soaked for some hours in a strong solution of bichloride of mercury. Of course, any food receptacle could be similarly protected since the ants do not cross the treated bricks. An outbreak of ants in beehives at Cedara was not successfully combated by this method, although a standard solution of bichloride was used. They crossed the bricks and entered the hives as before. A tin of tanglefoot (the substance used on fly paper) was resorted to, each leg being encircled by a thin layer of it. This has been entirely effective for six months without retouching and is still sticky. The same method was used to protect a meat safe after a poison bait (treacle, old bananas and sodium fluoride 2 per cent.) had failed. The bait merely repelled the ants for the time being. Liquid tanglefoot is non-poisonous. It is easily applied in ribbon form with a stick.

It is not known why the bichloride method failed at Cedara. Very probably its success depends upon the species of ant concerned. The ant referred to is not the Argentine ant. We do not know yet what the species is.

Crop Rotation.—It is not advisable to sow teff on the richest soil; leave this for other crops, such as maize, Kaffir corn, or beans. Arrange the hay crop to form the last crop in the rotation. As a general rule it is not necessary to fertilize teff, because if the soil is too rich for it, lodging of the crop will ensue.

With the exception perhaps of teff, any other crop can follow early harvested (November) potatoes. Maize is as good as any.

If an early variety of beans is grown, there will then still be time for a winter crop about March—as, for example, rape, oats, etc.

The Natal Farm in November.—November is a very busy month on the farm; ploughing, harrowing, cultivating, rolling, and planting are all operations of paramount importance, and to do them in a thorough manner now is to save time, labour, and expense later on.

The following is a list of what may be planted during the month: Broom corn, cowpeas, linseed, millets, peanuts, soya beans, sunflowers, teff, beans, Kaffir corn, maize, melons (with maize), pumpkins (with maize), Sudan grass, spineless cactus.

In certain areas, however, several of the above may be planted next month.

If in the past you have found the correct variety of crops for your district and your soil, then grow the same again, if not, then one or more of the undermentioned might perhaps prove to be the best selection. They have all been tested out from time to time and with good results, viz.:—

(a) *Beans (early and dwarf varieties)*.—Canadian Wonder, Small White Haricot, Natal Red, Small White Dwarf, Sugar, Yellow Dwarf. *(Mid-late in maturing, runner varieties)*.—Large White Kidney, Large White Haricot.

(b) *Cowpeas*.—Iron, New Era, Purple, Mixed, Wonderful, Whip-poor-will.

(c) *Maize (for the main crop in maize-producing areas)*.—Hickory King (White Dent), Potchefstroom Pearl (White Dent), Golden Beauty (Yellow Dent), Natal White Horsetooth (White Dent),* Ladysmith Pearl (White Dent),* Natal Yellow Horsetooth (Yellow Dent).*

Early varieties for (a) *late planting*, (b) *an early crop*, (c) *the non-maize-producing localities* (colder districts).—Natal Eight-row Yellow Flint, Yellow Cango (Yellow Flint), Chester County (Yellow Dent), Wisconsin (White Dent), White Cango (White Flint).

(d) *Millets (for hay and green food on vlei lands)*.—Japanese Millet. *(For hay and green food on hillside soil)*.—Golden or Foxtail Millet. *(For green food and silage)*.—Pearl Millet (Babala Grass).

(e) *Peanuts*.—Virginia Bunch, Tennessee Red, Spanish.

(f) *Soya Beans (for hay and silage, medium to late in maturing)*.—Chinese White, Mammoth, American White, Southern. These are also heavy grain producers. *(For seed and early maturing)*.—Brownie, American Speckled.

(g) *Sunflowers*.—Mammoth or Giant Russian (striped), Black Russian.

GROOTFONTEIN, MIDDELBURG (CAPE).

Slaughter Oxen.—At the recent Middelburg show, three cross-bred Hereford-Afrikander oxen, 6 years old, entirely veld grown, were entered for competition and took 1st and 2nd prizes. They were sold by public auction to local butchers and killed locally, giving the following return:—

No.	Live Weight.	Dressed Weight.	Percentage.	Sale Price.
1	2,016 lb.	1,289 lb.	$64\frac{1}{4}$	£18 16 6
2	1,904 lb.	1,210 lb.	$63\frac{1}{2}$	£17 0 0
3	1,770 lb.	1,110 lb.	$62\frac{3}{4}$	£16 0 0

* Best suited for districts with a very long growing season.

Annual Sale.—The annual sale of pedigree stock was held in September, and was successful compared with that of the previous year. The prices obtained for Frieslands were satisfactory—bulls, six of which were under one year, averaging £25. 6s. 3d., the lowest price being £15 and the highest price £42. 10s. Friesland females averaged £17. 8s. 9d., ranging from £7. 10s. to £27. 10s; as two of the cows were 16 years old and one 12, these prices are regarded as good. Five Percheron colts were sold, at prices from £60 to £120, the average being £89. The principal attraction, however, was the sheep, which realized a total of £815. 5s. for 46 rams and 36 stud ewes. Four Wanganella stud rams sold at £100, £95, £35, and £30, and two Tasmanian stud rams at £27. 10s. and £19 respectively. Flock rams sold from £5 to £8. 10s. each. There was a keen demand for old Wanganella stud ewes, a pen of which realized £14 per head. Young Wanganella stud ewes sold from £7 to £13 per head. Angora rams realized from £1 to £2 and angora ewes from £1. 1s. to £1. 15s. per head.

Planting out of Spineless Cactus.—In pursuance of the general policy of planting out spineless cactus in the various paddocks, we have recently planted eight different plots on various parts of the farm with the Fusicaulis variety. Each plot is approximately 1 morgen in extent and contains about 1,900 leaves. To protect these plantations from stock during early growth each plot has been fenced. The plots have been so selected that although there are only eight, they will conveniently serve fourteen paddocks and, incidentally, the whole farm. It is hoped thus to establish plots of spineless cactus in the vicinity of each paddock so that in times of drought it will be unnecessary to cut supplies from the main plots for the various paddocks, thus saving time and labour.

Outbreaks of Animal Diseases: September, 1925.

Disease.	Transvaal.	Natal.	Cape.	Orange Free State.	Transkei.	Total for Sept., 1925.	Total for Calendar Year. 1924.
East Coast Fever	1	4	—	—	—	5	125
Mange	22	16	22	26	20	106	455
Anthrax	18	5	5	10	25	63	1,494
Dourine	—	—	2	—	—	2	14
Glanders	—	—	7	1	—	8	56
Tuberculosis	—	—	1	—	—	1	18
Epizootic Lymphangitis	—	—	—	—	—	—	2

THE GREAT DROUGHT PROBLEM OF SOUTH AFRICA.

VI.—The Ill-results of Veld-burning and the Value of Trees.

A Practice to be Discouraged.

Since the early days of South Africa's history veld-burning for the purpose of assisting nature to replenish the pasturage has been practised. It has been discussed by generations of farmers, and many are still convinced that it is a beneficial practice. But the Commission advocates that veld-burning should be discouraged, though it realizes that this will be difficult with such a deeply rooted custom which is still far too prevalent. Yet, on the whole, it finds that grass-burning is on the decrease, and indeed that in sweet veld it is exceptional for grass to be burned. The improvement of the veld as a result of grazing control is now generally recognized, while an increasing employment of paddocks will greatly reduce veld-burning.

The natural dying down of grass and the decay thereof returns to the soil the substances which the plant has withdrawn therefrom, and it may at the same time enrich the soil with organic matter derived from the air. But veld-burning destroys a great deal of the useful covering of the soil; and it is this covering, like the mulch on cultivated land, that keeps down the temperature of the soil and obstructs excessive evaporation. By destroying this cover the speed of the run-off of the rain is accelerated and the quantity absorbed by the soil is consequently reduced. It is obvious that standing grass, and still more, grass standing in an entanglement of decaying growth, helps to prevent the run-off. For instance, the Commission saw a small valley with gentle slopes on the one side of which the veld had been burned, while on the opposite side the grass had been left standing. After a drought of seven months there was a good shower of rain, with the result that the dongas on the blackened side of the valley all carried water, while the dongas from the unburned pasture were dry.

Timber instead of Stock.

There are many farmers who say that grass-burning is the only practicable way of getting rid of the dead innutritious grass of the previous season, for to cut the grass with machines is impossible owing to the lie of the land, while to graze it off would entail serious over-stocking for many months of the year. Even with such farmers, however, paddocking would doubtless relieve the situation greatly. But there is another aspect of the matter. Grass-veld which grows so vigorously that it cannot be grazed down by full stocking is naturally tree-veld rather than grass-veld. If stock-farming is only possible with the aid of grass-burning, should not the farms in such areas be devoted more to timber production than to stock-raising? It opens a profitable field of enterprise, for the world price of timber is likely to rise.

THE DESTRUCTION OF BUSH.

The white man has been exhorted to stop veld-burning, but it was a native custom before the arrival of the European, and much damage continues from this source. In the vicinity of native reserves the bush is ruthlessly being destroyed for the building of huts, for fuel, and also to provide from time to time new lands in place of the old which, through continuous cropping without manuring, have become impoverished. This practice of cutting down and burning of bush touches the vitals of our existence.

Nor is it only the European farmer and the native who are responsible for the trouble: the mines have been a very active cause of destruction. Trees have been felled in the vicinity of the mines for fuel, while to-day timber and brushwood flanking the rivers in the neighbourhood of the alluvial diggings are being removed. It is true that destructive veld-fires are far less prevalent now than seventy-five years ago: the miles and miles of waving grass are no longer there, or are certainly not continuous. In the old days fires, starting at one spot, would roll on unstopped over areas which to-day are divided into as many as three magisterial districts. One still hears of accidental fires in Bechuanaland roaring their way across some seventy miles of veld before they are stayed or exhaust themselves through lack of fuel. But in those earlier times, when many of our mountain tops and slopes were covered with primeval forests, veld-fires were accompanied by far greater loss than to-day.

PROHIBITING GRAZING.

The Commission unequivocally states that veld-burning is contrary to the interests of the country as well as to the principles of veld and soil conservation which it advocates so strongly. Yet it, reluctantly, cannot recommend stringent legislative action to put it down. It is rather a matter depending upon the co-operation of the individual, who must be educated to realize how detrimental veld-burning is, the ultimate goal being to stop all veld-fires and increase fencing and tree-planting. Above all, veld-fires and the destruction of bush must be prevented in those comparatively small areas of superlative value as catchments of our irrigation streams. Thus, neglecting for the present the large plateau areas of sour grass, attention must first be given to the steeper mountains (many of which are Crown lands) of our main catchments. To effect this by legislation against firing is not practicable, but it can be attained in an indirect way. Firing of the grass is not usually done accidentally or wantonly, but for the purpose of producing young, green veld. If, therefore, grazing the mountains be prohibited, fires would naturally not occur so frequently and may entirely cease. The Commission consequently recommends that steps be taken immediately to stop all trespassing on Crown lands in such localities, and that rights to graze which are enjoyed by private farmers be withdrawn as soon as possible. Thereafter other areas, forming the headwaters of streams, should from time to time as may become necessary be proclaimed reserved areas on which the grazing of stock is prohibited. Some individuals may suffer, as a result particularly of the latter prohibition, but the prosperity of the State is at stake. There are means, however, of compensating the few adversely affected and to divert their energies into channels more beneficial to themselves and the State.

TREE-PLANTING FOR THE NATIVE.

The native's custom of accumulating his live stock is leading to over-stocking, to congestion, and so to the endangerment of certain of our demarcated forest areas, due to the demand for more elbow-room. If such mountain areas are given over to these natives, not only will the catchment be ruined, but the alleviation of the natives' troubles be purely temporary. The need for more land would continue. But if these areas, so necessary for the preservation of the flow of our rivers, were put to timber (for which they are better suited) an enormous field of industry would be opened to the natives, a field which, added to better methods of cultivating their lands, would probably enable the present area to support the natural increase in population for generations to come. Thus in respect of veld-burning alone, and all that it means, is seen the important rôle that tree-planting is destined to fill in removing a bad practice of long standing.

THE VALUE OF AFFORESTATION.

Although there are some who think that isolated clumps of trees can "attract" rain, there is no foundation to such belief, and it is generally accepted by experts that forests, excepting those located in particularly favourable situations, do not increase the rainfall in their vicinity. They do reduce the temperature of the air and may also reduce the severity of rainstorms; but on the other hand, many species of trees consume much moisture and frequently dry up springs in their neighbourhood. Therefore it seems that, however extensively it may develop, afforestation in South Africa is not likely to alter the general character of our climate, and if the object be only to increase the rainfall, any large scheme of afforestation would not pay.

A programme of extensive afforestation is, nevertheless, necessary. It will lead to decreased soil-erosion and a more economic use of the rainfall, the preservation and improvement of mountain catchment areas, and the regulation of the flow of rivers and the clarification of the waters thereof.

Rain falling on forests is retarded in its fall to the earth by the leafy canopy, and reaches the earth with a decreased velocity and a reduced destructive force. The trees themselves, and the sponge-like litter of leaves in all stages of decay lying beneath them, act as obstacles to the rainwater running off. The time of contact between the water and the soil is thereby greatly lengthened, and opportunity for soaking into the soil is increased. Useless evaporation is reduced. The underground water, provided the trees do not transpire excessive quantities of water, is strengthened, and the perennial flow of springs assured. The surface water, running off more slowly, causes less soil erosion, and the binding effect of the roots of the trees renders the soil more resistant to the action of running water. There are further advantages. With a more regular flow of rivers, the size of reservoirs for irrigation would be reduced. Winter irrigation from streams should become possible, facilitating the growth of winter crops, and increasing the possible area of land that would be cultivated.

AN ENORMOUS LOSS.

What the actual annual loss of soil to the Union through transport by rivers is, is at present unknown. From such information as is obtainable, the Commission was able to make a rough estimate

that in the season 1919-1920 some 187 million tons of earth, equivalent to 94 square miles of soil one foot deep, were carried away by our rivers. This will indicate the enormous annual loss of soil, but the actual area ruined annually may be much greater; for although much of the portion eroded is gouged out to a depth deeper than one foot, much of the area lying between adjacent sloots is also ruined.

CLOTHING THE MOUNTAIN SLOPES.

A considerable portion of this soil comes from the steeper areas of the various catchments. To prevent this, afforestation is needed in the mountains, and it is in the mountains that the most favourable sites for plantations are found. The grass-burning areas suggested to be more suitable for tree-growing than stock-raising are mostly these same mountain areas. If these steep areas are put down to timber, a great deal of soil erosion will be prevented. Further, on the lower and less steep slopes, the water accumulated from the higher portions rushes away with increased velocity, and also does its share of damage. The effect which afforestation would have on the reduction of the loss of our valuable soil by staying these destructive factors is evident. And thus afforestation will form an essential feature in the proper preservation of our river catchment areas.

THE EXPERIENCE OF WAR.

While the methods recommended by the Commission for the conservation of our soil are of wide and national importance, they will also bring direct personal gain to the individual. And so it is with tree-planting. A study of our imports will show that timber and timber products comprise to all intents and purposes one-half of the necessities imported from overseas. The experience of the Great War taught us that being cut off from free communication with other countries for many years will severely handicap our progress. In such eventuality factories of various sorts would certainly spring up, provided always the necessary raw materials were available. South Africa could produce in such circumstances sufficient quantities of materials necessary for continuous expansion and progress, with the exception, perhaps, of the following major articles:—Nitrates, mercury, sulphur, paraffin, petrol, rubber, and timber. And timber equals in value (over three million pounds yearly) the total of the remainder of the above materials imported.

We cannot create mineral deposits, but we certainly can establish plantations. Thus it is necessary from a broad point of view to grow more timber with the object of making our country much more self-supporting. The saving of some three million pounds yearly is in itself sufficient inducement and evidence that timber-growing will pay.

IMPROVING THE COUNTRY.

Apart from timber production, tree-planting may be practised for other purposes connected with the improvement of the country. There is its value in ornamentation. There is its great need as shelter-trees for stock: farmers in their own interests are urged to do all they can to plant such trees. This can be done, as in many parts of the Orange Free State, in the form of two intersecting lines forming a

cross which will afford shelter for stock no matter from what direction the wind comes, or in some other form according to local requirements.

Tree-planting may also be desired to reduce wash on slopes without doing away with the use of that area for grazing. For such purposes, that is for the production of "park lands," trees which do not transpire freely, and which permit sunlight to percolate through their foliage, should be chosen. Camps or paddocks treated in this manner are of great value to the stock farmer.

To break the force of torrents, a thick layer of decaying vegetable matter is useful. To produce this, broad-leaved deciduous trees are the most efficient. Such trees demand much moisture and will take it from the soil. Large volumes of water will be held for gradual delivery, and a considerable proportion will be permanently removed. The total run-off or yield of the valley is decreased, while in all probability the total amount which may be used is increased; for of the rushing torrent only a small proportion may be put to use (except at a prohibitive cost for storage), while the tamed stream could perhaps be led directly on to cultivated lands. In other parts again prevention of soil erosion may better be secured by vegetation which stools and trees which readily produce suckers.

VEGETATION FOR BARE PATCHES.

There are many bare patches in the Karroo where the vegetation fails to re-establish itself without artificial aid. On such areas even a few branches pegged down will afford a sufficient windbreak to permit the collection under and around the branch of enough wind-blown material to form a seed-bed in which the growth of the native vegetation is made possible. Windbreaks established across such an area would result finally in bringing it all under vegetation. But in most of these parts it is difficult to get trees to grow. The Commission suggests the American aloe (*Agave*) as a substitute. It is highly drought-resisting, serves as an excellent windbreak, besides which it provides valuable fodder. Grown as a fence it collects a considerable deposit of sandy material on the windward side, and in this seeds of the mimosa have been known to germinate and grow into big trees which give both shade from the sun and an annual crop of nutritious fodder. There may, however, be other trees or bushes even more suitable than the American aloe, and the Commission recommends that investigation should be carried out to determine what varieties are the most suitable for the drier areas, when provision should be made for establishing nurseries at which seedlings are obtainable.

The value of tree-planting, to the individual, to the State, and to posterity, is clear to all, and the Commission, which does not concern itself with any technical discussion as to varieties of trees beyond urging that *those used on the river catchment areas should not be of too high transpiring power*, adds its evidence in advocating that both State and private afforestation enterprise should be encouraged.

(NOTE.—For further details, read Chapters XXVII and XXVIII of the Final Report of the Drought Investigation Commission.)

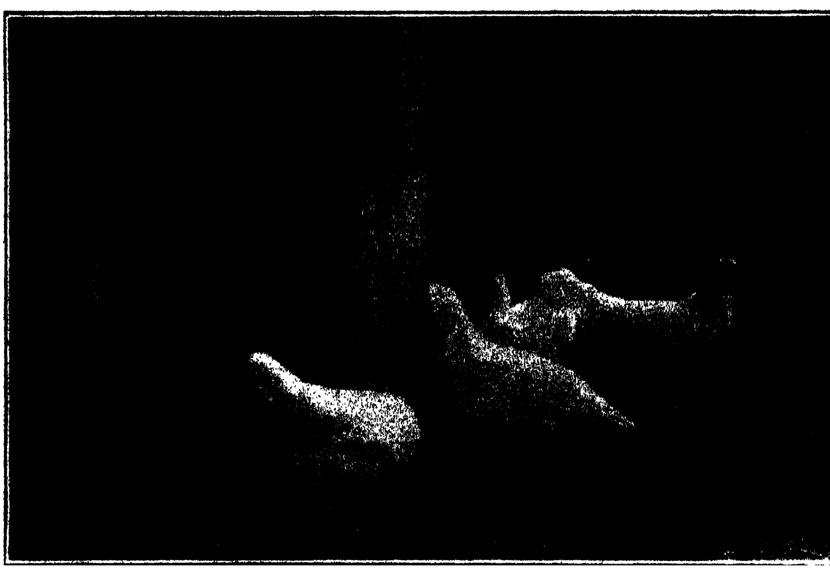
(*To be continued.*)

INTENSIVE POULTRY-KEEPING FOR TOWN DWELLERS.

Fourth Year's Report.

By J. J. JORDAAN, Poultry Instructor, School of Agriculture, Glen, O.F.S.

ON the 1st April, 1921, six White Leghorn pullets were taken at random from a flock of 50 odd and were started off on a test, the object being: (1) to arrive at some idea of the food cost of producing eggs for the home under city or town backyard conditions—where space is limited; and (2) to test, in this connection, the small intensive house system under typical South African conditions.



The four remaining hens of the original six. They were 54 months old when the fifth year's test was started on 1st May, 1925.

The details and results of the first test were published in this *Journal* of November, 1922, and reprinted in pamphlet form for distribution to the public, for which, it is pleasing to note, there was a great demand (as also for subsequent pamphlets on the test).

Due to the satisfactory results, it was decided to test the same birds for a second year to determine whether it would be more economical to retain for another year or to replace them with six pullets. The results of the second year's test were given in the *Journal* of July, 1923, and published in pamphlet form; they conclusively showed that it would be economical to keep the birds for the second year as egg producers for the home.

It was decided to continue the test again for another period of twelve months with the same birds—now thirty months old—under exactly similar conditions, for the purpose of arriving at some idea of their value for the purposes of which the test was first started; also whether it would be more economical to replace them with pullets; and as to what their capabilities were of continuing to produce eggs fresh and sweet for the home at the minimum of food cost, or replacement by fresh outlay. The results of the third year's test were published in the *Jouranl* for October, 1924.

As the results for each of these three years were so encouraging it was decided:

(1) to keep the birds until it was found their age prevented them from being economic egg producers;

(2) to arrive at some idea of the age of profitableness of a bird's life, providing they are of a laying strain and well cared for under South African climatic conditions;

The six pullets that have been started off on similar test to that which their mothers were submitted to the first year.

(3) To breed a limited number of chickens from them under such conditions. (*a*) To test their breeding capabilities, and to see (*b*) if close confinement would be detrimental to fertility, hatching, rearing, constitution, and production in their progeny by the health, vigour, length of life and eggs produced by the latter under similar conditions; and (*c*) thus from the above results to determine if it would be necessary for town dwellers to buy new pullets yearly to replace the old ones, or if they could not successfully hatch and rear a small number required for replacement from hens that had proved economical and profitable egg producers.

And so with the above objects in view the birds—then 42 months old—were started off on their fourth year's test on the 1st May, 1924. The test was again for twelve months and concluded on the 31st April, 1925, the period dealt with in this report more particularly. And the results of their egg production for the period being so satisfactory, they have been started off on the fifth year's test, in accordance with the intentions mentioned in the third year's report, i.e. that published in the *Journal* of October, 1924.

Of the fourth year's test the following details will no doubt prove interesting and useful to breeders and backyard poultry keepers.

Two birds died during November, 1924, one from kidney trouble and the other from prolapse of oviduct.

The following qualities of food with the value (as bought) were consumed:—

Article.	Quantity.	Price.	Amount. £	s.	d.
Grit	8 lb.	9s. 6d. per 100 lb.	0	0	9
Shell	8 „	10s. per 100 lb.	0	0	10
Charcoal	5 „	6s. 6d. per bag of 75 lb. ...	0	0	5
Wheat screenings	85¾ „	9s. 3d. per 100 lb.	0	7	6
Oats	39¾ „	12s. 6d. per bag of 150 lb. ...	0	3	4
Mealies	77 „	6s. per 100 10...	0	4	7
Kaffir Corn	24 „	8s. 4d. per 100 lb.	0	2	0
Bran	50 „	8s. per 100 lb...	0	4	0
Crushed Oats	18 „	8s. 10d. per 100 lb.	0	1	7
Pollards...	20 „	12s. 3d. per bag of 150 lb. ...	0	1	7
Meat Meal	7½ „	8s. per 100 lb...	0	0	7
Green Food	200 „	4s. 2d. per 100 lb.	0	8	4
Scratching Material	4 bales	1s. per bale	0	4	0
			£1	19	6

The number of eggs produced was as follows:—1924, May 12, June, July, and August 76, September 67, October 79, November 68, December 72; 1925, January 59, February 48, March 40, April 9. Total 530.

The average cost to produce one dozen eggs during this period was 10.7d. Summarized, the results over the four years were as follows:—

Food Cost—	£	s.	d.	Average per bird. s.	d.
First year for 6 birds	3	13	4	12	$2\frac{2}{3}$
Second year for 6 birds	2	14	6	9	1
Third year for 6 birds	2	13	3	8	10½
Fourth year for 5 birds*	1	19	6	7	11
For the whole period. Total...	£11	0	7		

* Taken as for five birds, the two hens that died having been fed from May to November, and a male bird added from 26th May, 1924 to 30th September, 1924.

The average cost of feeding six birds for one year over the whole period was 9s. 2d.

The production of eggs—

		Average per bird.
First year	1,476	245
Second year...	1,050	175
Third year	1,052	175½
Fourth year...	530	106
Total for 4 years... ...	4,102	
Average per year from 6 hens ...	1,025 eggs.	

The two houses containing the four old hens and the six pullets—their daughters.
NOTE.—Lids over run and sleeping chamber open.

The average cost (food only) per dozen over the whole period being $7\frac{7}{10}$d.

The average cost (food only) per dozen over the first year being $7\frac{1}{5}$d.

The average cost (food only) per dozen over the second year being $7\frac{1}{2}$d.

The average cost (food only) per dozen over the third year being $7\frac{3}{10}$d.

*The average cost (food only) per dozen over the fourth year being $10\frac{7}{10}$d.

According to the eggs laid monthly it will be seen that although the birds had commenced to lay in May, as soon as the male bird was introduced into the house the birds were so affected as to stop laying.

* *Note.*—During this period a male bird was also fed for four months.

The nervous and unsettled state they got into was most noticeable, and it undoubtedly affected their production and contributed towards the much increased cost per dozen during the period.

The weights of the birds at the close of the year were respectively, 4 lb. 9 oz., 4 lb., 4 lb. 8 oz., 4 lb. 8 oz., say, 17½ lb. in all.

THE BREEDING TEST.

In connexion with the breeding test, the following are the details.

A male bird, unrelated, was introduced into the house on the 29th May, 1924, and removed on the 30th September, 1924, i.e. being kept with the hens for four months and four days. The number of eggs put into the incubator was 62, of which 43 or 69.35 per cent. were fertile: 31 of the eggs hatched, being 50 per cent. of those put into incubation or 72.09 per cent. of the fertiles hatched.

In rearing, 20 out of the 31 hatched reached maturity, or 64.52 per cent., the sexes of those reared being 11 pullets and 9 cockerels. Six of the pullets were placed in a small intensive house identical to that occupied by their mothers from the commencement of this test, to compare their stamina for production, over their first period, with that of their mothers.

Of the five remaining, three were placed in single pens at the same time with 33 other White Leghorn pullets, also in the single pens, to test their egg production under semi-intensive conditions, the other birds being from the same strain, but hatched and reared from tested and trap-nested breeding stock running under semi-intensive conditions.

The results have still to be seen.

It is interesting to note that, at least, there has been no deterioration in size of the birds hatched from the four old hens. The six pullets placed in the intensive house weighed at the commencement of the test respectively 4¼, 4½, 3½, 5, 4¼, 3½ lb. (total 25 lb.), as compared with their mothers' respective, 3¼, 3, 4, 3, 3, 3¼ lb. (total 19½ lb.) at the close of their first year's test.

The four old hens that remain of the original six are again being tested for twelve months. At the start of this test they were 54 months old.

In fairness to the test the following two points must be mentioned:—

(1) The poultry manure of the birds for the period has some value for the garden, either flower or vegetable, and

(2) no table scraps have been available or used as would be the case in a home. Thus, where such are available and used, the food cost given above will even be reduced.

PACKING DECIDUOUS FRUIT FOR EXPORT.

By RALPH J. BULMER, Chief Government Fruit Inspector.

IN writing on this subject there are so many points to be taken into consideration that it is necessary to go into details with regard to the handling of not only the different classes of fruit, but also in some instances to the different varieties of certain kinds of fruit. On the other hand, it is very difficult indeed to lay down a hard and fast rule as to how the several fruits should be packed, having regard to the number of fruits to be packed in the different grades. The cause of this difficulty is that some packers in grading their fruit endeavour to pack all they can of the higher grades, and to this end they grade just large enough to pass the inspector; whereas, other packers grade their fruit so high that a large proportion of it could be packed in a higher grade than what they are marked.

In making the following recommendations, it is presumed that the packer has graded his fruit in so far as quality is concerned and has sized it correctly:—

In packing all sorts of fruits, packers should bear in mind that economy in space is money saved, and, therefore, they should endeavour to pack as many fruit as possible into the box without doing any damage to the fruit by bruising, etc. Those fruits which must be packed in woodwool should be packed with as little of it as possible, enough being used just to keep the fruit from being bruised by contact with fruit next to it, or with the top or bottom of the box. Woodwool used excessively is harmful, as it prevents the circulation of air through the boxes and thus retards the cooling down of the fruit. Also when fruit is packed at the right stage of ripeness and too much woodwool is used, it will take too long to precool in the cool chambers; this results in the ripening process continuing so long after the fruit is placed in the cool chambers that it will arrive on the market in an over-ripe and perhaps unsound condition.

APRICOTS.

In no part of the world is the apricot a popular dessert fruit, and there is a very limited demand for it on the European markets; packers who wish to do so can pack small fruit, but the writer would strongly recommend nothing smaller than fruit of the "selected" grade. Under the Government regulations controlling the export of fruit at present in force, apricots are described as "Early Cape" and "any other variety"; there are four outstanding varieties of the latter which will always command a good price if the fruit is of good size and colour, and they are: "Royal," "Bleinheim," "Tilton," and "Moorpark." All apricots should

be packed when they are ripe, but not over-ripe. On no account should they be packed green, for they will arrive in a flavourless and woolly condition.

For the actual packing it is only necessary to line out the box with woodwool. No woodwool whatever should be placed between the fruits: all apricots should be packed on the diagonal system, which is less likely to cause bruising, allows more fruit to be placed in the box, is much more attractive than the straight pack, and is easier to pack.

NECTARINES.

Nectarines under existing regulations are classed as "Gold Mine" and "all varieties except Gold Mine." There are numerous such varieties that are recommended for export; they are all, however, much of the same size and can, therefore, be treated in the same manner when being packed. All varieties that ripen up to the time of "Gold Mine" should be packed in a ripe condition; the later varieties can be packed in a slightly firmer condition, but must be fully matured. Great care must be taken in handling nectarines when packing them; they are a very delicate fruit and easily bruised. It is necessary to use woodwool between the fruits in sufficient quantity to hold them firmly in the boxes; at the same time the woodwool must not be pressed too tightly in between the fruits, for if it is, the fruit is liable to get bruised.

PEACHES.

All peaches, with perhaps the exception of "Gladstone" and "Sea Eagle," should be packed in a fully ripe condition; if they are packed green they will arrive on the market woolly, flavourless, and practically uneatable. When packing peaches it is essential to use woodwool between the fruits to prevent the fruits from becoming bruised; only sufficient should be used to prevent any likelihood of bruising. A large quantity of woodwool prevents a free circulation of air and retards precooling.

PEARS.

On no account should pears be packed with woodwool between the fruits; only sufficient woodwool should be used for lining out the box to keep the fruit from coming in contact with the box. The object of the packer should be to get as much fruit into the box as possible. It is recommended that all "extra selected" and "selected" pears should be packed in single layer boxes, but fruits of "choice" and "graded" grades of the hardier varieties can be packed in larger boxes.

PLUMS.

In the packing of all varieties of plums no woodwool is required between the fruits. The different varieties of plums, however, vary very much as to the stage of ripeness in which they should be picked. "Methley," "Satsuma," "Santa Rosa," and "Apple" should be picked in a fully ripe condition, in such a condition that

they are still firm, but practically fit to eat. "Sultan," "Kelsey," "Chalcot," "Formosa," "Gaviota," and "Beauty" should be picked when they are beginning to show colour, that is to say, they must not be picked green. "Wicksons" should be picked when the points are yellow, but they should not show any red.

A SYSTEM OF PACKING.

The following is a statement showing the number of fruits and the system of packing that I recommend for all the above-mentioned fruits; the diagonal pack is strongly recommended for all:—

Variety.	Extra Selected.			Selected.			Choice.		
	Count.	Style.	No. of Rows.	Count.	Style.	No. of Rows.	Count.	Style.	No. of Rows.
Cape Apricots	40	5×5	8	45 or 50	5×5 6×5	9 9	50 or 55	6×5 6×5	9 10
Other Apricots	36	5×4	8	40 or 45	5×5 5×5	8 9	45 or 50	5×5 6×5	9 9
Satsuma Plums	36 or 40	5×4 5×5	8	45	5×5	9	55	6×5	10
Kelsey Plums and Wickson Plums ...	32 or 36	4×4 5×4	8 8	36 40	5×4 5×5	8 8	45	5×5	9
Apple Plums, Sultan Plums, and Chalcot Plums	32 or 36	4×4 5×4	8 8	45	5×5	9	55	6×5	10
Santa Rosa and Beauty Plums	50	6×5	9	55	6×5	10	60	6×6	10
Formosa and Gaviota Plums	32	4×4	8	41	5×4	9	50	6×5	10
Goldmine Nectarines ...	28	4×4	7	32	4×4	8	36	5×4	8
Other Nectarines ...	24	4×4	6	28	4×4	7	36	5×4	8
Elberta Peach ... ... Early Rivers Peach ...	15	3×3	5	18	3×3	6	21 or 24	3×4 3×4	6 7
Other Peaches	18	3×3	6	21 or 24	3×4 4×4	6 6	24 or 28	4×4 4×4	6 6
Pears—									
Bon Chretien, Beurre Bosc, Beurre Hardy, Clapps Favourite, Josephine, Superfine, Rustenburg, and Flemish Beauty ...	21	4×3	6	25	4×3	7	28	4×4	7
Comice and Glout Morceau	18	3×3	6	21	4×3	6	28	4×4	7
Louise Bonne, Winter Nelis, and Josephine	25	4×3	7	28	4×4	7	32 or 36	4×4 5×4	8 8
Keiffer	13	3×2	5	15 or 18	3×3 3×3	5 6	21 or 25	4×3 4×3	6 7

In a number of instances I have given two styles of packs for the same grade; this I have done where there is a big margin between the grades above and below the ones mentioned.

Great care must be taken by the packer to see that all fruit is of equal size in each individual box.

GRAPES.

To lay down a system for the packing of grapes is very difficult indeed; so many different styles of packs have been exported successfully that I do not wish to dogmatize. I strongly recommend, however, the 10-lb. box for some varieties of grapes, such as the "Gros Colman," "Gros Maroc," and "Henab Turki"; the box 6 in. deep should be used for most other varieties, but the 5½ in. deep box is also satisfactory.

The box should first be lined out with woodwool, not an excessive quantity, but just enough to keep the grapes from coming in contact with the sides or bottom of the box. The bunches should be properly trimmed, all straggly berries should be cut out, and only one bunch should be wrapped in a paper (this at present only refers to "extra selected" and "selected" grades, but I strongly recommend this for all grapes), and in my opinion the bunches should be completely wrapped. When placing the bunches in the box, they should be put in a slanting position to prevent the weight of the bunch coming on to the point or end of the bunch, and enough woodwool should be placed between the bunches to keep them apart and firm in the box. An excessive amount of woodwool is most detrimental to the keeping qualities of the grapes; the gross weight of the box should be at least 14¼ lb. to allow for 10 lb. of fruit. Packers should frequently weigh their boxes to be sure of getting the correct net weight.

A GUIDE TO GRAPE PACKERS.

As a guide to packers for grading their grapes, I wish to make the following recommendation as to the size of the bunches, and size, or rather number of berries, to the pound, also the sugar-content of the grapes. The figures given below are for "selected" grade. The packing of a large number of small bunches of three or four berries in one wrapper is deprecated:—

Variety.	Weight of Bunch.	Berries to lb.	Sugar Percentage.
Hermitage	8 oz.	100	19 per cent.
Hanepoot	10 to 12 oz.	80	20 „
Rosaki and Waltham Cross ...	10 to 12 oz.	75	18 „
Barbarossa and Lady Downe ...	12 to 14 oz.	95	19 „
Molenera Gorda, Gros Colman, and Henab Turki	14 to 16 oz.	70	19 „
Raisin Blanc	10 to 12 oz.	80	19 „

By taking an occasional bunch and testing it by the above system, the packer will be able to arrive at what I consider an ideal size for "selected" grapes. Any grapes larger than above, provided the berries are of uniform size and free from all blemish, can be packed as "extra selected" grade.

FRUIT DRYING IN SOUTH AFRICA.

By L. PERKINS, Dried Fruit Officer, Elsenburg School of Agriculture.

ONE of the oldest and most important methods by which food can be preserved is by drying. Several factors, such as war, drought, and famine, have influenced this industry to a very great extent, until to-day we find, even in South Africa, that drying is one of the most important ways by which fresh fruit is conserved.

Apart from the fact that dried fruit is a much more concentrated form of preservation, this conservation can be arrived at more cheaply and economically than by canning, firstly, because of the fact that sugar is not used, and secondly, a cheaper form of labour, less skilled, is required.

Less storage space is required. "A ton of apricots after canning weighs approximately 2,800 lb., if the weight of cans and boxes is included. A ton of fresh apricots yields about 400 lb. of dried fruit, which when packed will weigh not more than 450 lb., or less than one-sixth as much as an equivalent amount of canned fruit."*

It can readily be understood, therefore, that the cost of the transportation of dried fruit is much less than for canned or fresh.

FUNDAMENTAL PRINCIPLES OF DRYING.

It is not what is performed in the cutting-shed or dry-yard, etc., that makes for the successful drying of fruit, but the year's work in the orchard of irrigation, fertilization, ploughing, etc., combined with the harvesting operations. It is an impossibility to produce a good dried article from poor fruit.

That good fruit may be spoiled is true, but usually what happens is that the packer has to handle a dried product produced from a crop after the shipper and canner have had their pick. Because dried fruit is a lower grade and produces a cheaper product, it should not be given a cheap and slipshod handling. It must be remembered that large-sized and clean fruit handles easily and the finished product sells best. In this connexion one might mention the great importance of thinning. It takes ordinarily the following number of peaches per pound to the different grades:—

Californian Grades.

Standard	...	108 half-peaches to the lb.	@ 10 cents per lb.
Choice ...	...	64 ,, ,,	@ 12 ,,
Extra Choice	...	44 ,, ,,	@ 14 ,,
Fancy ...	...	34 , ,,	@ 15 ,,
Extra Fancy	...	26 ,, ,,	@ 17 ,,

* After Cruess.

There are three other important points to remember when imagining that windfalls, culls, and small fruits are good enough for producing good dried fruits:—

(1) Picking small stuff costs half again as much as picking big fruit.

(2) Because of the greater number of pits, weight lost is greater.

(3) It cost three times as much to cut and pit small fruit.

CONDITION OF FRUIT AT PICKING.

The fruit should be thoroughly mature, good colour, with highest sugar-content possible. Fruit picked green is entirely unsuitable. It will produce a dried article with poor flavour and colour because it has not this flavour and colour to start with. For instance with pears, the dried product will be a greyish green instead of a golden yellow.

Fruit consists principally of sugar, cellular tissue, and water; and thus after removing the water by drying, what is left is principally sugar. Ripe fruit contains plenty of sugar, and if ripe fruit is dried we get greater weight than if green fruit is dried. Do not, however, go to the other extreme and allow the fruit to get over-ripe before drying. Pick the fruit from the trees, do not shake it off. This practice not only breaks off fruit spurs, but also bruises, giving a dark dried product and a gritty, dirty one. Of course, with the prune this method of ripening is necessary, but not for other fruit. Even with this fruit, pick over the ground frequently, at least every week, to prevent insect-infestation, fermentation, and infection by micro-organisms. The sugar-content in raisins and peaches is also most important.

PREPARATION FOR DRYING.

By this we usually mean, in the case of peaches and apricots, the cutting and pitting; pears, the cutting and coring; apples, the peeling, coring, and ringing; prunes and raisins, the dipping.

Very often the question arises, "Why not dry fruit whole?" This is principally due to the fact that the standards in the world's markets have been developed on cut-fruit lines, but still there is no reason why whole fruit cannot be dried. Principally, therefore, they are not known on the market. Cut fruit, however, sulphurs easily, as there is double the surface exposed, also for drying. Thus speed is obtained, necessitating fewer trays and less dry-yard space. It is also reasonable to assume that the moisture cannot evaporate from the centre round the pip as quickly in whole as in cut fruit.

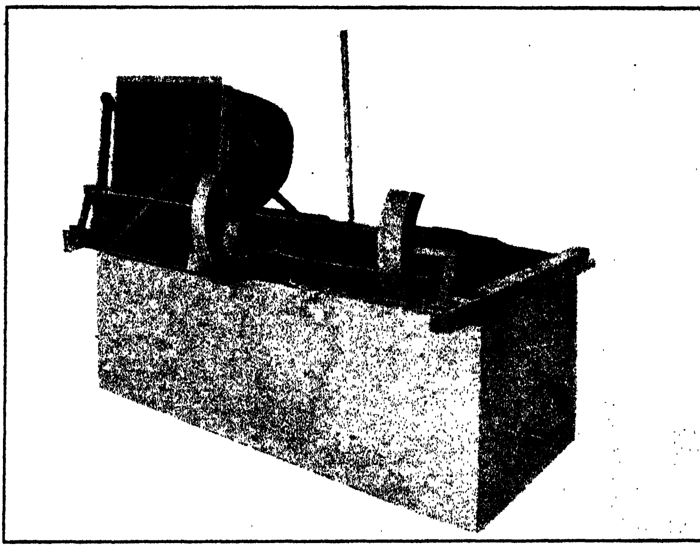
An interesting experiment carried out in the Santa Clara Valley, California, on apricots dried whole proved a success during the past season. The apricots were dipped in a caustic solution in a similar way to prunes, and were well dried. The resulting product had a delightful flavour when cooked, and this is caused by the liberation of the oil of bitter almonds. The only trouble foreseen was that insect-infested apricots, particularly around the pips, could not be detected.

With regard to mechanical cutters, the Dunn Pipper will not cut so quickly or so expertly as experienced cutters, there being no true suture cut.

DIPPING.

Prunes and grapes are alkali-dipped in caustic soda, lye, or sodium carbonate, etc. This tends to produce a cleaner product. Wax of the natural bloom retards the evaporation of moisture from the fruit. Dipping causes the checking or cracking of the skin, which aids rapid evaporation; this is very important, especially during bad seasons, for the faster the drying the lesser amount of fermentation is obtained.

Figure 1.



"Pioneer" or hand dipping machine. The illustration shows one basket on the left out of the boiling lye, while the one on the right is ready for receiving the fruit.

SULPHURING.

This operation in fruit drying is beneficial, because—

(1) it prevents the darkening of the fruit;

(2) sulphur causes the cells of the fruit to rupture, causing moisture to ooze out into the cups. Thus sulphured fruit will dry a little quicker than unsulphured of the same variety;

(3) agencies aiding spoilage cannot develop so readily in sulphured fruit.

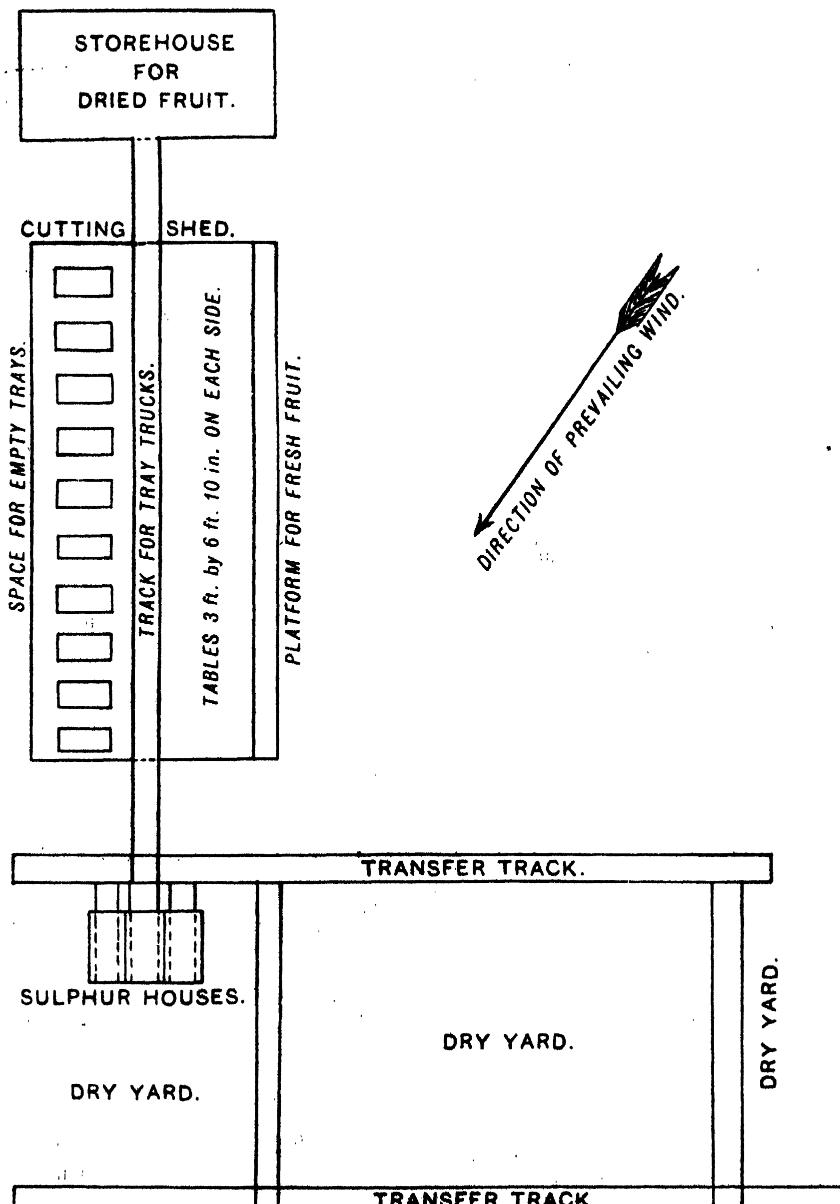
DISPATCHING TO PACK-HOUSES.

The practice of using disgustingly dirty grain-bags and dirty boxes which would not even make good garbage boxes, should be discouraged by packers for the dispatch of dried fruit from the grower to the pack-house.

Grain-bags actually roll the fruit, and, because of the method used for grading dried fruit over shaking screens, fruit when graded upon arrival at the packing-house will grade a lower grade than it should ordinarily, thus causing the grower a loss.

OUTLINE OF SUN-DRYING OF FRUITS.

Figure 2.



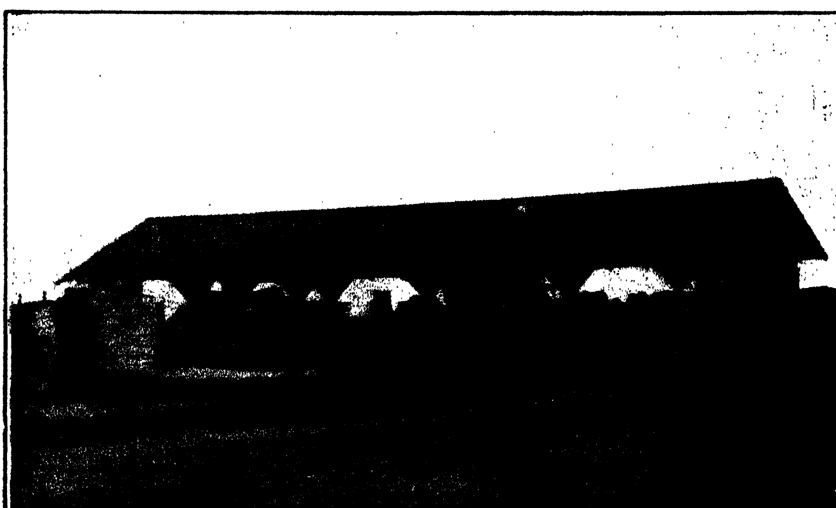
Cutting Shed and Drying Yard.

Equipment.

1. *Dry-yard.*—(a) *Clean Floor.*—Generally speaking, Californian dry-yards consist mainly of fields which have been previously sown to some cereal crop, and cut to leave the grain stubble fairly long. This prevents the movement of dust while operating the trays, either when stacking or setting out. It will also readily be seen that the trays do not rest heavily upon the ground, being buoyed in the air, thus facilitating a free circulation of air below the tray, hastening the drying of the fruit. The dry-yard should, where possible, slope away from the cutting-shed, a grassy slope being preferred.

(b) *Protected from Dust.*—When choosing a site for a dry-yard, consideration should be given to roads. Any traffic along roads situated in close proximity to the dry-yard will from time to time cause clouds of dust to blow over the drying fruit. All necessary

Figure 3.



Cutting Shed.

precautions should be taken to keep the roads of the yard watered frequently to prevent this. Where possible, suitable windbreaks should be planted for protection.

(c) *Northern Exposure Preferable.*—In order to get the maximum amount of light and heat the dry-yard should face the north or north-east.

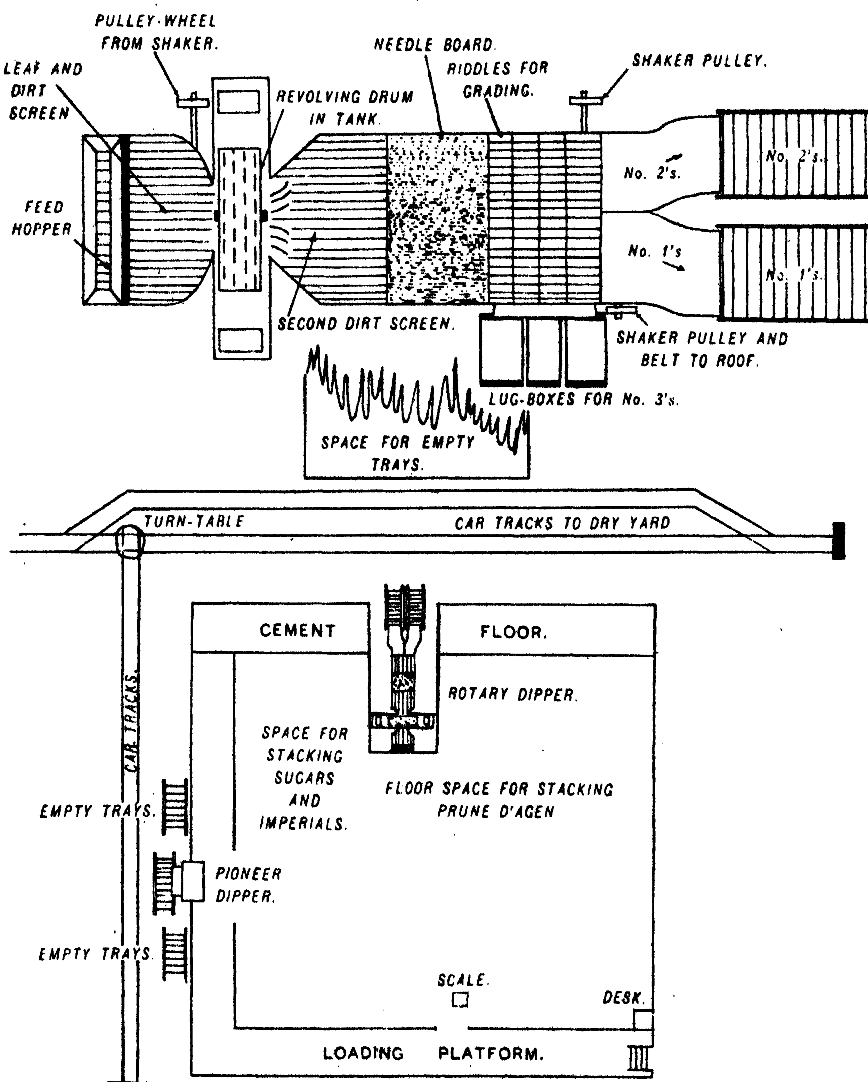
(d) *Area of Dry-yard* dependent on kind of fruit and acreage:

(i) Usually for prunes one acre is necessary to dry the product of 20 acres.

(ii) Apricots, peaches, pears, 1 acre to 20-30 acres, depending on the variety, manner of curing, and local weather conditions.

2. *Sheds.*—(*a*) Cutting-sheds for apricots, peaches, pears, apples, should have open sides, admitting plenty of light and air. These may be cheap structures of ordinary round timber or poles, the roof being thatched or roofed with sheet iron to protect the workers

Figure 4.

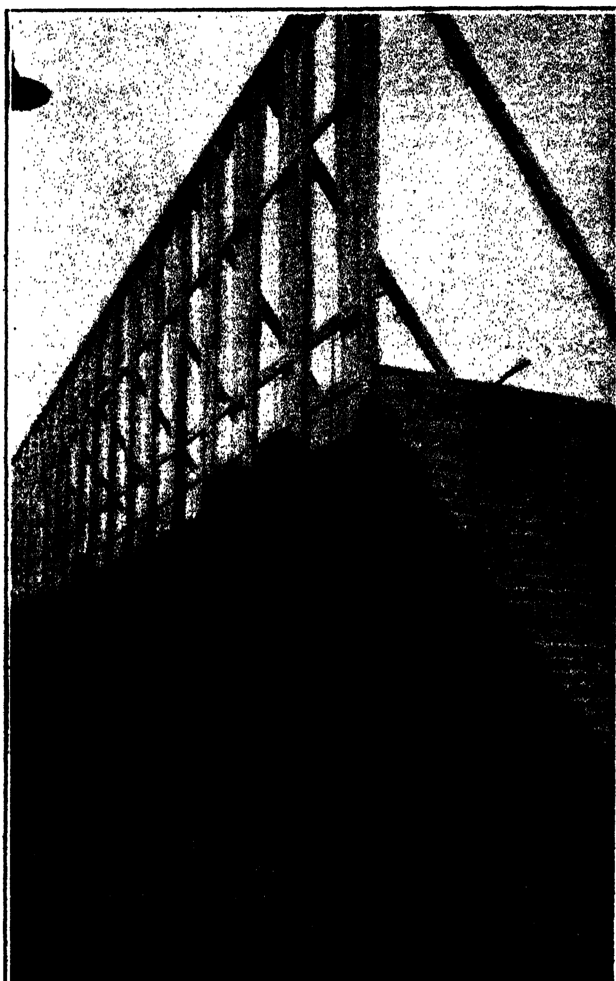


Principle of a Rotary Prune Dipper and Arrangement of Prune or Raisin Dipping Floor.

during the warm weather. During the off-season these structures may be used for stacking empty trays, trucks, picking-boxes, and other portable dry-yard equipment. Very often where oak-tree shade is obtained the car-lines can be constructed so as to facilitate handling

of the cut fruit either to the sulphur-chambers or direct to the yard. Whichever method of protection is used, the cutting-tables should be arranged on both sides of the track to allow rapid handling of the filled trays. A water-faucet should be placed at each end of the shed for attaching wash-up hoses. The cutting-sheds should be of ideal location and arrangement. Where possible, the cutting-shed should be right on the dry-yard, with the tracks for easy distribution of the trays.

Figure 5.



Sulphur Chambers.

(*b*) The prune and raisin shed should be arranged to house the dipping machinery and equipment. It is important to have the unloading platform and scale on the same level as the trucks and wagons, as the trucks can be more easily operated between the wagon,

scale, and dipping machinery. The grading end of the machine should be on the ground-level, as the trays of dipped prunes are stacked on the relays of low orchard wagons or trollies on tracks. The prune-dipping house should be kept scrupulously clean, with no evidence of decaying or trampled fruit. Live steam is often used when cleaning up for the night.

3. *Sulphur-houses.*—Sulphur-houses are of various types, and should be large enough to accommodate 8-foot trays or smaller, depending on acreage and whether sun-drying or dehydration is used. Eight-foot trays are usually called " field " trays, and can be used in some types of dehydrators. Usually 3-foot trays are used for drying grapes in the vineyard rows or else in small dehydrators in California. The 8 feet by 3 feet is recommended for South African conditions, and should fit snugly into the sulphur-houses when stacked on the trolley.

(a) *Permanent Type.*—These are made of concrete, brick, or wood, and are of various sizes, in number according to acreage. A useful size is 6 feet high, 4 feet wide, and 10 feet long, with a door and sulphur-pit at the front end. Another very useful type is made of single brick walls, concrete roof, sliding sheet-metal door in front, and a sulphur-pit at the back with a door of same material. In this type the chambers may be fired independently and the pots may be withdrawn when necessary without trouble of fumes worrying the crew removing the sulphured trays.

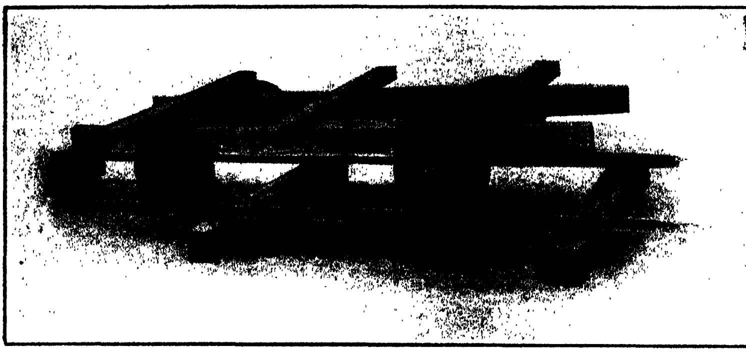
(b) *Temporary Type.*—These are made of light wooden frame and covered with black or white building paper, usually called a sulphur hood or balloon hood. The inside measurements can be the same as those of the permanent type, but are easier to handle if only about four feet high. This frame is placed over a stack of trays in the field and removed after the sulphuring has been completed.

4. *Cars and Tracks.*—(a) *Turn-tables and Transfer-cars.*—In order to obviate the transferring of trays from one car to another once they have been stacked for sulphuring, turn-tables for switching from one track to another should be installed. It is usual to have the trucks laid in the sulphur-houses about 12 inches above the field tracks so that a transfer-car can be used. A transfer-car is an ordinary trolley with rails across it. It is really a portion of the track on wheels, and is used for transferring the field or tray cars from one track to another, such as from the sulphur-house to the field track.

(b) *Plan of Yard Arrangement.*—It should be seen that the tracks lead from the shed to the sulphur-houses and from there to the dry-yard, with a return track for empty trays and picking-boxes of dried fruit. This is in the case of pears, peaches, sultanas, apricots, apples, etc. For prunes and raisins the tracks run direct to the dry-yard from the dipping-shed. Where any fair amount of fruit is handled by the grower, it will pay him to get away from team or truck hauling and lay field tracks. Everything should be arranged so as to make for rapid handling and easy working.

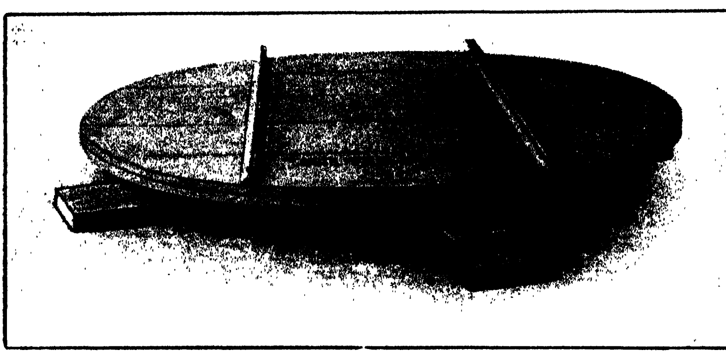
Boxes.—Sufficient boxes should be supplied for fruit storage in the fresh state. Clean boxes should be reserved for the dried-fruit handling. A number of boxes should be set aside for use in

Figure 6 (*a*).



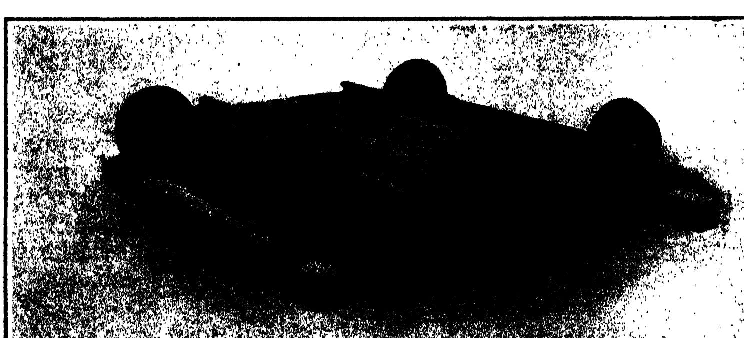
Field Car.

Figure 6 (*b*).



Turn-table.

Figure 6 (*c*).



Transfer-car.

the cutting-shed, as nothing is more objectionable than handling either clean fresh or dried fruit in dirty, damp, or discoloured boxes. Not only is this practice bad, but at the same time commences the growth of moulds on fruit. After use, the cutting-shed boxes should be scrubbed out and dried to prevent souring and fermentation. Pits and peelings should be dumped in garbage-cans and removed daily. Peelings make excellent hog-feed or fertilizer.

Trays.—Eight feet by three feet field trays are used commercially, but the actual sizes are left to the preference of the grower. Some growers use 6 feet by 3 feet, while others prefer 8 feet by 3 feet. The actual sizes also depend upon whether a dehydrator or sun-drying is used. At the beginning of the season every tray should be scrubbed in fresh clean water, thoroughly dried, and stacked away in the cutting-shed. A revolving brush, run by a 3-h.p. motor, is an excellent machine for removing moulds from trays after winter.

Cutting-tables.—It is not necessary to have special tables. Trays and trestles are all that are needed, for as soon as one tray is filled it is removed by the floor-boys and stacked on the car.

Knives.—These should be kept sharp and clean. Cheap wooden handles with blades of good steel are better than expensive knives. Corers may be made from watch-springs bent to suit.

Prune and Raisin Dipping Machinery.—Prunes and grapes may be dipped either by hand or machinery. Where a large quantity is to be processed, machinery is absolutely necessary, but where a small amount only is handled, hand-dipping is cheaper.

Prune dippers are usually of two kinds, made in different sizes to suit individual requirements—(1) Pioneer machine, (2) Rotary or drum dipper.

1. *Hand-dipping by Basket.*—This system is fast passing out of use in California, for with community dipping and drying the small-holder, unless he has a fairly large quantity to handle, can profitably devote his time to some other fruit-harvesting operations, such as fresh-fruit packing, etc.

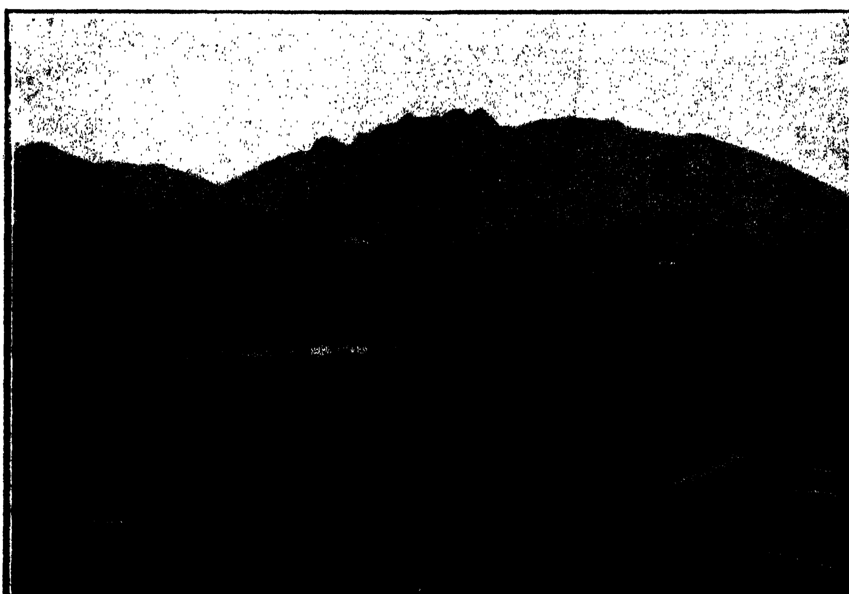
Usually a furnace of brick and mortar is built around a small boiler, and the prunes or raisins are dipped into the boiling lye solution either in flat-bottomed wire baskets containing a single layer of grapes or five or six inches of prunes, or else in wicker baskets. The objection to the latter container is that it not only loses its shape, but at the same time uneven cracking results. This operation is a tedious one, and very unpleasant burning accidents frequently occur. At the same time the furnaces for hand-dipping are usually stoked with wood, and an uneven heat is obtained. For successful dipping, the water should be kept at constant boiling point, and this is difficult to obtain with wood fuel. Steam heat is an improvement, but where hand-dipping is used the expense might be too great.

2. *Pioneer Machine.*—This is a simple machine mounted above a tank and furnace and operated by a lever. When the lever is up, the basket drops below the level of the lye in the tank, and the fruit is simply dumped into the boiling solution. Upon pulling

the lever down, the basket scoops, lifts clear of the lye, bringing the fruit with it like a strainer, and shooting it into the hopper below. From here the fruit can be fed to trays at will, which rest on the shaker below. The baskets are used singly or in pairs. On the latter machine the first basket, after dipping into the lye, shoots the fruit into the second, which dips the fruit into washing water, and in turn dumps it into the feed-hopper. The usual capacity of this machine is one to two tons per hour, depending upon the operator. (Figure 1.)

3. *Rotary or Drum Dipping.*—To supply the demand for a machine of increased capacity when compared with the Pioneer or

Figure 7.



Drying Yard.

Basket machine, a large machine with a continuous rotary drum is manufactured, adapted for the rapid handling of different sized trays. This dipper drum consists of a revolving perforated cylinder braced with sheet-iron partitions which take the fruit below the surface of the lye, bringing it up and out again something like cork-screw fashion. It is an ideal machine for prunes, but shatters grapes badly. The machine has an advanced feed-hopper and dirt-screen. The fruit then passes through the revolving drum and out over another screen. From there it runs down over the "pricker board" and on the grading riddles. The pricker board consists of a number of boards thickly set with needles. These prick the skins of any prunes which may have missed the lye.

To divide the fruit into three grades, two screens are provided, and over these screens the largest grade or No. 1's are carried and

delivered directly to the shaking tray. The middle grade or No. 2's pass along a lower screen and are delivered to another tray lying alongside the trays catching up the No. 1's. The smallest grade or No. 3's drop through both riddles and pass out through a shute where they are caught in picking-boxes. The No. 1's and 2's trays located side by side are sloped away from the machine on a fruit-spreading device which is given an oscillating motion by means of a shaker or pitman attached to the grading equipment.

The usual capacity of these machines is 5-6 tons per hour; the power required to operate the machine is a 2-h.p. motor. A larger machine with an 8-9 ton capacity requiring a 3-h.p. motor is also manufactured. This machine can only be used for the French Prune d'Agen. Sugars and Imperials will skin completely.

Trucks.—These vary in construction, one having certain points in favour of it, while another will have others. Trucks should be kept clean, particularly the wheels, which, if gummed and sticky, make the operating of the truck most difficult.

Furnace Construction.—The mortar for the brickwork should contain a fair amount of clay, for if the mixture is too rich in cement, bad cracking will result from heat.

APRICOT DRYING.

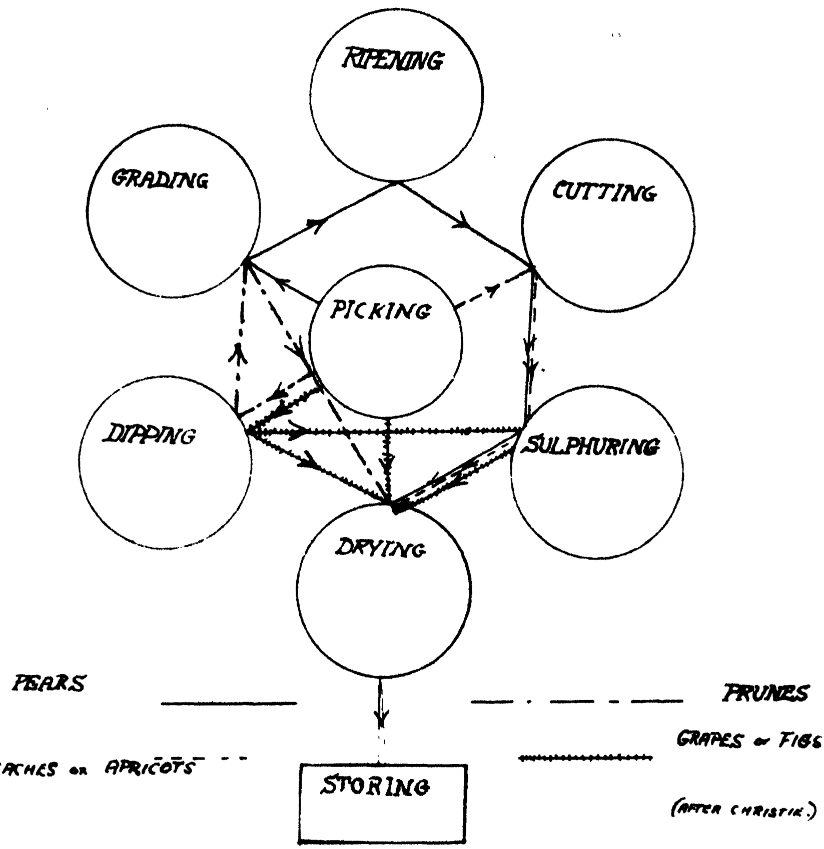
Varieties of Apricots and Adaptation.—The principal varieties of apricots used for drying are the Royal, Early Cape, Blenheim, Tilton, and Moorpark. Of these the most popular is the Royal. This is recommended in California for planting at the coast and coasting valleys. The Moorpark gives a fruit of size and good quality, but is inclined to be a shy, irregular bearer. At the same time it does not ripen uniformly, often " dead " ripe on one side and " hard " ripe on the other. It also ripens in the centre, while the outside is still too hard for picking. Royals are recommended for the interior plantings in South Africa.

Drying Ratios.—Drying ratios run from 4-7 to 1, depending on variety, size, degree of ripeness, and care in drying. It will be found that Royals will give the best drying ratio apart from Moorpark. Degree of ripeness also plays a very large part. Over-ripe apricots will dry away to skins and slabs, while green apricots, although giving weight, never cure satisfactorily.

Degree of Ripeness.—The fruit should be choice for hand-eating or dessert. In other words, the fruit should be well ripened, without signs of insect injury or blemishes, juicy, and sweet. The fruit should be carefully picked by hand, and not shaken from the trees and picked from the ground. Picking by hand has shown to produce five pounds of slabs per ton, while by shaking, knocking, and picking 60 pounds of slabs per ton results. Fruit may be placed on trays to await cutting up. By this means any fruit slightly on the green side will ripen up in the stack.

Cutting.—After picking according to ripeness, the fruit should not be in the boxes for longer than twelve hours, or else softening or moulding will commence. It is usual in California for two

pickers to keep one cutter busy. It is important to cut the fruit carefully around the suture, leaving no jagged edges. Care should be taken to see that the cutters do not slip the pits without cutting right round the apricot. This practice is particularly bad when apricots are being cut by contract. The cut fruit should be placed uniformly on trays, cup up, taking care not to "mush" the fruit. Cutting is usually contracted at so much per box in California and per tray is South Africa. Before sulphuring, the fruit on the trays should be well sprayed with water to increase the penetration of the



Fruit Drying—Order of Operation.

sulphur if the fruit presents a dry appearance. If ripe and mushy, this is not necessary.

Sulphuring.—The amount of sulphur to use and the length of sulphuring is dependent on the degree of ripeness and type and size of sulphur-house, etc. The average amount of sulphur to use is 2 lb. per 100 cubic feet, and the average time of exposure to the fumes four to five hours. It is usual to sulphur the morning's cutting as soon as possible, and that of the afternoon all night. Sulphuring is completed when the cup is full of juice, and fruit when broken across shows 75 per cent. to 80 per cent. of penetration,

so that after the fruit remains in the dry-yard for some time it does not turn dark. The fruit should be sulphured as soon after cutting as possible. Rock sulphur is recommended.

Sun Exposure.—The trays are placed in the field after sulphuring, arranging the trays for the maximum exposure.

Sun-drying versus *Stack-drying.*—Sun-drying solely is too drastic. The fruit dries too rapidly, while stack-drying alone is apt to give a very poor coloured product—in fact, the fruit often moulds badly.

Sun-drying plus Stack-drying.—This is the best proven method for apricot drying. The fruit should be exposed to the sun for approximately four days, *finishing* in the stack according to weather conditions and temperature. It will be found that by this method good colour and texture are obtained, with splendid "feel," quality, and body.

Indications of Drying being Completed.—This is the most difficult portion of the whole business, and not only are years of experience necessary, but expert judgment year after year. Practically every year conditions are different; in fact, each batch of fruit is likely to differ, depending on the area where it is grown. The best time to "feel" the fruit in the stack is early morning; during the day the fruit appears very dry, while during the night a certain amount of moisture is taken up and its true condition can be better judged. Generally speaking, a point midway between the rattling on the tray and a clammy feeling is just right. If a handful is pressed together, the fruit should fall apart in the palm when released, none of the individual fruits sticking together.

It is naturally impossible to find each individual fruit in the same stage of dryness; some will be a little moister than others, while some will be bone-dry. This unevenness will be corrected when the fruit is placed in "sweat-boxes" to even up in moisture and cure.

Grading and Culling.—It is at this stage that a great deal of excellent work can be done by the grower which will be of valued assistance to the dried-fruit merchant or packer, preventing the entrance of poor-grade fruit into the factory mixed with good fruit but delivered separately for separate processing. Before the apricots are scraped together on the trays a certain amount of culling should be done, which will not only improve the general appearance of the fruit, but will mean better prices for all concerned. The yard crew should be divided into pairs, and one pair put to each stack of trays. A number of picking or lug boxes should be provided for each stack, also two trestles, the fruit being pushed together and loosened with wooden paddles.

Before disturbing the fruit, however, all slabs are separated from the bulk. These slabs are perfectly good fruits, but have unfortunately dried misshapenly and stuck to the trays, caused either by poor cutting of the fruit or careless handling of the trays. These are loosened and placed separately in boxes for later sale to confectioners and bakers. The rest of the fruit is then loosened and

scraped together with paddles, and all culls should be picked out. These consist of all sunburns, scabs, cracks, or splits, mouldy or black smutted fruits, and are placed together in one box.

The rest of the fruit is boxed in lugs and stacked to prevent drying out prior to removal to the pack-houses; and over-moist fruits should be set aside on trays for further drying.

Sweating.—Before delivery to the packer, apricots should be sweated ten or fifteen days in either lugs or sweat boxes. This "evening-up," as it is called, is part of the curing process, and materially affects the condition of the fruit, giving it character, body, and "feel." As explained before, any unevenness in moisture-content will be corrected, and when ready for delivery should be uniform in moisture-content.

PEACH DRYING.

Varieties Recommended.—The two most popular varieties recommended for planting in California are Muirs and Lovells. Elbertas and other yellow varieties such as Foster, Susquehanna, Crawford, Wheatland, and Salway may be dried satisfactorily. Nectarines may be treated similarly. Clingstone varieties cannot be pitted economically and give a low yield of dried product because of their low sugar-content. The above is also recommended for South African conditions.

Drying Ratios.—Drying ratios average for Muirs 5 lb. fresh fruit to 1 lb. dried, 5 to 1 for Lovells, and Elbertas 7 to 1, depending upon size and condition of ripeness.

Degree of Ripeness.—When drying "unpeeled," the fruit should be firm ripe when picked, and handled very carefully to prevent bruising. The fruit should be picked as for immediate consumption.

Cutting.—Cutting should follow picking of the fruit as soon as possible. Cut completely around the ridge, leaving no jagged edges when the fruit is halved. Remove the pit carefully. Place the pieces, cups up, on the trays. All these operations should be done as rapidly as possible to prevent darkening of the cut surfaces.

Sulphuring.—The usual quantity used is 8 lb. of sulphur per green ton of fruit, exposing the fruit for four hours. Indications of sulphuring being completed are shown when the skin slips easily by rubbing; juice in the cups; and when broken across the fruit will show 75 per cent. to 80 per cent. penetration.

Exposure to the Sun.—See under Apricots.

Grading and Culling.—As in the case of the apricot, culls are picked out, particularly any discoloured, scabby, or smutty fruits. Slabs are kept separate, but it will be found that there are always less slabs among peaches than apricots. The balance are placed in sweat-boxes to "even-up."

Indications of Drying being Completed.—Peaches should be well dried, but not sufficiently to make them rattle upon the trays. Good peaches should have a fine, soft, pliable feel, not at all leathery

but like wet buck-skin. When examined on the cup side, the core should not extend, and should not be coarse. The flesh should be glistening. Dull-looking fruit denotes green condition when picked. The general colour should be golden like a sovereign.

Storing and Sweating.—Prior to delivery, peaches should be stored in sweat-boxes so as to "even-up" in moisture-content and cure.

PEAR DRYING.

Varieties Recommended.—Of all varieties of pears Williams' Bon Chretien is the only one recommended for commercial drying in California. It is the shipping, canning, and drying variety of the United States of America. In South Africa, however, such varieties as Beurre Hardy, Bosc, etc., are also dried.

Drying Ratio.—The drying ratio of Williams runs from 4-6 to 1, with an average of 5 to 1.

Handling.—The pears are harvested green and ripened in lug-boxes, or are spread in thin layers upon straw on the pack-house floor. They should be graded as to size, soundness, freedom from bruises, and codling-moth infestation. When ready for cutting, they should be sorted as to ripeness.

Cutting.—Pears are cut when ripe for eating—bright yellow colour on under side and blush on sun side. Cut a strip of half-inch wide longitudinally around the pear from stem-end to calyx, and back again on the other side. Halve through this peeled portion, and remove stem, core, and calyx. In California the pear is simply halved and cored, placed upright and uniformly on trays, and placed in the sulphur-chamber as soon as possible.

Sulphuring.—Stack the trays on the cars without delay, and run into the sulphur-chambers. In California the fruit is exposed to constant sulphur fumes for 48 hours in Lake County, using 12 lb. of sulphur per green ton. Indications that sulphuring is completed—complete penetration essential. In South Africa it will be found that from 8-12 hours is sufficient, according to the size of the fruit.

Sun Exposure.—The following is the Californian practice in Lake County where vast quantities are dried:—Expose the sulphured fruit to the sun for 4-5 hours when very hot, but usually one or two days. The principal curing takes place in the stack. This takes 10-12 days early in the season and 3-6 weeks or more later on. The curing is complete when the product is leathery to the touch and no soft pouches present. In South Africa two-thirds of the drying should be done in the sun, finishing off in the shade.

Grading and Culling.—The fruit should be culled to free the bulk from scabs, smuts, and discoloured fruits. Slabs should be kept separate.

Finished Product.—After sweating, the finished product should be white, translucent (will show shadow of finger through the dried product). No red colour should be tolerated on any of the fruits. When a handful are squeezed together, individual fruits should not adhere together.

PRUNE DRYING.

Leading Varieties.—The leading varieties in South Africa are:

(1) Petite, or Prune d'Agen (French).

(2) Imperial.

(3) Sugar.

(4) Robe de Sergeant.

(5) Fellenberg (Italian-German). Not widely planted on account of shy bearing.

Harvesting.—Prunes are allowed to drop to the ground from the tree. Pick prunes up every few days according to acreage. The fruit should not be shaken from the trees, except when cleaning up for the last picking.

Drying Ratio.—The usual ratio for prunes generally is $2\frac{1}{4}$-4 to 1.

Sugar...	2.69 lb.	to 1 lb.	dried.	
French	2.12	,,	,,	,,
Robe de Sergeant... ...	3.39	,,	,,	,,

Process of Drying.—It is necessary, in order to remove the bloom and "check" or crack the skin of the prune, to dip the fruit in a boiling solution of alkali. Such lyes as Babbits, Capex, Greenbank's Concentrated Lye, etc., and caustic soda are used. This hastens evaporation of the moisture from the fruit, increasing the rate of drying.

Home-made and Commercial Dippers.—Washer, needle board; grader, etc., refer to Prune-Raisin Dipping Machinery.

Strength of Lye.—Use an average of 4-10 lb. of lye to 100 gallons water, depending upon the variety. Some seasons the skins will be found to be much tougher than in others. The solution should be kept boiling. The above quantity of lye is sufficient for about 400 boxes.

Legth of Dip.—This will depend upon several factors.

(a) *The Type of Machine used.*—The length of dip in the Rotary machine is constant, and the amount of checking must be controlled by the strength of the lye. Either more caustic soda must be added to strengthen the solution, or else more water to weaken the solution.

In the case of the Pioneer or the Basket machine, the length of dipping is controlled by the operator. If the solution is of the correct strength, then he controls the checking by the length of dipping. In cracking or checking the prune, the prune should be covered with minute cracks, but the skin should not be jagged or thrown back. Overchecking will cause the fruit to dry out too rapidly, making them stick on the tray, and giving a poor product.

The length of dip should average about 5-15 seconds, and the water must be boiling. Watch the fruit closely for checking.

(*b*) The length of dip is different for different varieties. French d'Agen can be dipped for a longer period than Sugars and Imperials, which skin very badly and shatter.

(*c*) Some years the skins are more difficult to crack than others.

(*d*) *Condition of Ripeness.*—The riper the prune the more difficult it is to crack. Prunes should be dipped as soon after picking up as possible, as wilted prunes dip with difficulty.

Spread the fruit evenly on the trays from the grader, and set the trays out on the dry-yard according to the grades, keeping each grade separately. This will facilitate drying and handling to a wonderful extent, as it is absolutely impossible to dry large and small prunes on the same tray.

Sun Exposure.—Expose the fruit to the sun for approximately five days, turning the large prunes by raking over the trays with a blunt-pronged fork. The prunes should then be stacked for two days to two to three weeks, according to climatic conditions.

Indications that Curing is Complete.—The fruit should be leathery, pliable, and firm. The pit should not slip under the skin when rubbed between the thumb and forefinger. When a double handful is squeezed together and dropped, they should fall apart readily.

Grading and Culling.—(*a*) First quality based on colour and appearance; good dark colour, not red; properly cured.

(*b*) Second quality, poorer grade.

Before placing the dried fruit in lugs, they are culled to remove "chocolates," cracks, and "frogs."

"*Chocolates.*"—These are prunes of a reddish chocolate colour, and are usually green fruit to start with. The colour can be improved by redipping in boiling water to which a little lye has been added.

"*Cracks.*"—These originate from fruits which were originally cracked or split either by excessively irregular irrigation or else unfavourable weather conditions. Cracks are sold as a lower grade, usually as pie-prunes.

"*Frogs.*"—These are prunes, usually green fruit, which bloat and dry out to skin and stone. The fruit remains the normal round shape, but when pressed between the thumb and finger will be found to be blown up and filled with air. Frogs are of no commercial value, and are waste products to the drier.

Silver Prunes.—These are treated similarly to Imperial, but as there is no market for them few are dried.

Storing and Sweating.—Prunes are stored in sweat-boxes or bins for a week or ten days before delivery, so as to allow them to even-up the moisture-content.

RAISIN DRYING.

Varieties.—(*a*) For clusters or Malagas, the Muscat of Alexandria, Muscat Gordo Blanco, or White Hanepoot is recommended. These three names appear to be synonymous.

(*b*) For loose, stemmed, pudding, or confectioners' raisins, the Muscat is recommended; also the Malaga and Feherzagos.

(*c*) For seedless raisins, Thompson's Seedless, Sultana, and Black Manukka.

(*d*) For currants, very small, stemmed, seedless raisins from the Zante Corinth grape.

There are several new varieties giving great promise as raisin grapes, but no data are yet to hand concerning these.

Drying Ratios.—With most varieties the drying ratio will be found to be 4-5 to 1.

Degree of Ripeness.—The grapes should be fully ripe when cut and should not test below 20° Balling in any circumstances; in fact, the riper the better within reason. Muscats and Thompson's should both be of a rich golden yellow with a brownish russeting. Grapes more than most fruits are composed principally of sugar, cellular tissue, and water; and when the last has evaporated during drying, what remains proves the quality of the raisin. The greater the sugar-content the higher the quality of the product. It is because of this principle that one can never hope to make a raisin of quality from a thin watery grape which is lacking in sugar and character so often found among wine varieties. This is also true during abnormally wet seasons. It is impossible to expect a raisin of quality under such conditions, even Hanepoot or Sultanas.

Cutting.—The fruit should be handled as soon after cutting as possible, for before long a slow fermentation commences among any mushed berries. It is important to go through the vineyard at least three times in order to harvest uniformly ripe bunches.

Clusters or Malagas.—The practice in California, like that in South Africa, is to cut the grapes direct from the vine, placing them on trays to dry without any further processing.

The berries are not handled at all, the bunches drying with the waxy bloom still intact. This is, of course, a slow process, but necessary for the production of this special type of product. In California the trays are left in the vineyard rows, turning two or three times during the drying, according to the season. After drying, the layers or clusters are packed in sweat-boxes with care, to even-up in moisture-content.

Loose, Stemmed, or Lexia Raisins.—In California these are made in exactly the same way as the clusters, except that before delivering to the packers, because of a little less care generally in dumping them into the sweat-boxes, most of the berries will have dropped or rubbed off from the main stem or peduncle.

Dipping.—In South Africa, however, because of the short drying season, more speed in drying is necessary. Drying is hastened by dipping the grapes in a boiling lye solution like prunes, which checks or cracks the skin, allowing evaporation of the moisture to proceed more rapidly. The skin of the berries is very much more tender than that of the prune, and less caustic soda is needed. It is usual to have one pound of lye to thirty gallons of water, but the correct amount can be judged after a few trial dips. Rinse in running water or frequent changes.

Poor quality raisins are produced principally owing to the following reasons:—

(*a*) Grapes too low in sugar-content.

(*b*) Over or under dipping.

(*c*) Allowing the grapes to be submerged too long in the caustic solution.

(*d*) Not renewing the lye mixture often enough.

Sun Exposure.—After rinsing, the bunches are placed on trays and put out into the sun. Raisins take about 6-7 days to dry, and should be stacked a few days prior to the finish, as this greatly improves the quality of the product.

Seedless Raisins.—Thompson's Seedless or Sultanas are the varieties used for the production of this class of raisin, and either a straight Sultana or a bleached Sultana can be made.

Straight Sultanas.—In South Africa these are made by dipping in an alkaline solution. The bunches are simply dipped and placed directly on the trays for drying without any further processing. After drying, the raisins are stemmed, cleaned, and placed in cartons for sale. In South Africa this type of raisin is also made for a small trade with those who do not like the taste of a sulphured or bleached Sultana.

Bleached Sultanas.—These are made alike in California as in South Africa. The grapes are cut when well ripe, and are dipped in a caustic solution of lye, one lb. to thirty gallons of water approximately. After dipping, rinse in clean fresh running water, or several changes. Unlike the straight seedless Sultana, however, the berries are heavily sulphured, using about 2 lb. sulphur per 100 cubic feet for 5 hours. It is essential to get the trays sulphured as soon as possible after dipping, breaking the large bunches into smaller ones to ensure proper sulphuring, and the time of sulphuring can be regulated by chalking the time of commencement of sulphuring up on the door, or shifting the hand of the dummy pasteboard clock attached to the door. After sulphuring, place the trays out in the sun. Those trays coming out last thing at night can either be stacked out on the field, or should the chamber space not be required, the doors may be opened and the trays left in all night. Valencias are bleached Muscats.

Sun Exposure.—Bleached Sultanas should take approximately 6 to 7 days to dry according to climatic conditions, and it is advisable to finish the fruit off in the stack for a few days, according to the temperature of the dry-yard.

Indications of Drying being Completed.—(*a*) *Clusters.*—In the case of clusters, all the berries on the bunch should be uniformly dry, particularly any berries situated in the centre of the bunch. These sometimes mould unless care is taken. A few berries squeezed between the thumb and index finger should exude no juice. The berries when taken from the bunch and squeezed in the hand should not adhere the one to the other. The finished product should have a fine, soft, leathery touch.

(*b*) *Lexias and Sultanas.*—This is also true concerning these types of raisins, but they may be dried out a trifle more; for even if too dry, sufficient moisture can be replaced in them during processing to make them soft and pliable. Great care should be taken not to bring raisins into the house in too moist a condition, as they ferment and mould very readily.

Grading and Culling.—When placing the raisins in sweat-boxes for evening-up, any bunch with mould or over-moist bunches should be set aside for further drying.

Sweating.—Raisins should be evened-up in boxes 10 to 15 days before delivery to the packer, so as to have uniform moisture-content throughout.

Seeded Raisins.—These are loose stemmed Muscats which have been artificially seeded by machinery.

FIG DRYING.

Varieties and Adaptation.—Varieties which are commonly grown in California for drying are Black Mission, White Adriatic, and Calimyrna.

Black Mission.—"The only trouble with Black Mission is its colour." Thus did Mr. George Roeding, of Fancher Creek Nurseries, Fresno, California, sum up his opinion of the variety, and this seems to represent the opinion of practical fig-growers throughout that State. The colour prejudice against a black fig is well entrenched in the eastern markets of United States of America, and can only be overcome by years of intensive and expensive advertising and educational work. The black colour with prunes is no disadvantage in marketing; for practically all prunes are black, whereas most dried figs are light coloured. It would seem that the black colour is a detriment to the dried fig, but not sufficiently detrimental to warrant a good future for the Mission, considering its other qualities.

White Adriatic.—From the numerous varieties of figs introduced by nurserymen and others during the latter half of the eighteenth century into California, the White Adriatic took the lead and was widely planted both in orchards and borders as a drying variety. During the last three or four decades the Adriatic has proved itself to be almost a sure producer of bountiful crops which have generally brought the grower good returns on his investment. In fact, the term "mortgage lifter" has been frequently applied to the border Adriatic trees in various parts of the San Joaquin Valley.

It is claimed by Dr. Eisen that the true name of the Adriatic is Nebian, while Mr. Rixford, of the State Department of Plant Investigation, states that the correct name is Verdone, a famous drying fig grown in the vicinity of Rome. The writer knows from personal investigation that of the varieties grown at the Plant Introduction Gardens, Chico, California, No. 18876, known as Grosse Verte, and No. 18863, known as Nebian, are both identical to the Adriatic so widely grown in California

Caprification changes the character of the Adriatic, and in most cases improves it for drying. Where the trees are grown under the best conditions, that is, where the water table is not too high and the

atmospheric humidity low, the caprification of Adriatic figs is certainly justified and recommended in California.

The White Adriatic is an excellent fig when it is clean and sweet, but unfit for human consumption when it is sour and slovenly handled. The future of the variety would seem to depend upon the ability of the grower to deliver a better grade of figs, and of the marketing organization to increase consumption of cooking figs and of such products as fig meat.

Calimyrna.—At the first Fig Institute of the Peach and Fig Growers' Association held in 1917 the subject of the Adriatic *versus* the Calimyrna was discussed by several practical growers. Judging from the fact that since 1917 the plantings of Calimyrna have far exceeded the plantings of Adriatics, the former variety would seem to have had the best of the argument. Inquiries, however, among representative growers of many years' experience indicate that they are not entirely satisfied with the financial returns from the dried Calimyrna, and several are preferring the Mission for new plantings. Moreover, it is a well-known fact that the large independent packers in the city of Fresno prefer to handle crops of Adriatics, and that one such company has ceased entirely to handle Calimyrnas on account of the alleged high percentage of low-grade fruit. The high prices of fancy packages of Calimyrna figs are partly due to the comparatively small percentage of fancy figs available for such purposes. Inferior grades are due to splitting, sunburn, bird-pecks, poor colour, and fungous diseases, etc.

What, then, is the present status of the Calimyrna fig? Most agree with the statement made at one of the Fig Institutes of the Peach and Fig Growers' Association, which said: "Nothing is more delicious than the Calimyrna; nothing more remunerative than the Adriatic; nothing more certain than the Black Mission."

The growing of Calimyrna figs requires special attention to details, particularly in regard to caprification. Those who are willing to study and master the details of crop production, may expect good returns from this most excellent of figs.

Degree of Ripeness.—Figs for drying are treated in exactly the same way as prunes, and allowed to drop from the trees, when they are picked up and placed in trays to dry. This, however, is impossible in South Africa, for the figs sour readily on account of climatic conditions. The first picking particularly should be clean, so that all subsequent droppings may be more or less of the same period, thus giving a chance of more uniform drying and handling. Figs in South Africa should be picked for drying, and may even shrivel a little before harvesting. Figs which have been rained upon and are sour should be discarded and no attempt made to dry them.

Sulphuring.—In the case of Calimyrna and Mission, no sulphuring should be given. Many growers water the Adriatic, and a good sulphuring is given to improve the colour, making it bright-straw coloured or practically white. Eight pounds of sulphur should be used to each green ton, and the average time from six to twelve hours.

Sun Exposure.—After placing on the trays, expose the fruit for several days, depending on the stage of dryness at the time of harvesting and the climatic conditions. Finer skins are obtained if drying

is finished in the stack. Figs may be turned by raking over, similarly to prunes.

Indications of Dryness being Completed.—Figs are dry when, if broken open, no sticky mass is obtained where the pulp used to be, but at the same time the skin should be pliable, flexible, firm, with a slight leathery feel. To the smell there should be no sourness, and the taste should be a pleasant, soft, fig flavour.

Grading and Culling.—Any badly discoloured, split, or bird-pecked should be culled out, also "sours."

Sweating.—Figs should be placed in sweat-boxes to even-up in moisture-content for 10 to 15 days prior to delivery to the packing-house.

APPLE DRYING.

Apple Varieties.—The main varieties dried in the Watsonville area of Santa Cruz County, California, are Yellow Belle Flower and Yellow Newtown Pippin, although other miscellaneous varieties are often used. The Newtown is the better drying apple of the two. In South Africa such varieties as Ohenemuri, Versfeld, etc., are often used extensively.

Drying Ratios.—Good apples generally dry 6 to 1, while poor stuff will run about 7 to 1.

Degree of Ripeness.—Apples make the best dried product when hard ripe. In ordinary years only C-grade apples and culls are dried, but when prices for fresh fruit are low, a larger quantity of first-class stuff is dried.

Cutting.—Practically all cutting, peeling, and coring is done by machinery. This should be done as cleanly and neatly as possible, leaving no ragged edges. The "Rival" cutting and coring machine is used extensively.

Sulphuring.—The brine method is mostly used after leaving the corer, but often the fruit is sulphured for about an hour, using six pounds of sulphur per ton.

Sun Exposure.—In the Watsonville area no sun-drying is done. Dehydration is the method of drying used throughout this section. Four or five different types of evaporators are used; the average temperature is about 120° F. If exposed to the sun, it usually takes 3 to 4 days to dry the rings, sometimes less, according to weather conditions.

Indications of Drying being Completed.—No definite method of determining the time when apples are completely dry is used. It is a matter of experience and is decided by the "feel" of the fruit.

Grading and Culling.—When cleaning up the trays, pick out any very dark or dirty, gritty specimens, putting the remainder into sweat-boxes or picking-lugs, so that the fruit may even-up in moisture-content prior to shipping to the packing-house.

WEEDS OF SOUTH AFRICA.

By K. A. LANSDELL, Botanical Assistant, Division of Botany, Pretoria.

XVII.

[Like other countries, South Africa is awaking to the importance of suppressing its noxious weeds, which, owing to the alarming rapidity of their spread in recent years, are becoming increasingly dangerous to our pasturage, wool, and other agricultural pursuits. While much has been done in the past to place the farmer in a position to recognize and cope with the danger, the problem grows in seriousness, and the time has arrived when all information regarding the noxious weeds found in the Union should be gathered into one publication for the use of the farmer, the student, and the general public. This work has now been undertaken by the Division of Botany, the opening contribution, continued hereunder, appearing in our April, 1921, number. The publication, which includes an illustrated glossary on the morphology of weeds, is the first of its kind in South Africa, and will continue to appear in serial form in the *Journal*. Thereafter, the series will be reprinted in bulletin form, with the addition of a coloured plate illustrating each weed dealt with.—EDITOR.]

Weed No. 12.

THE "PROSTRATE STAR-BUR."

(*Acanthospermum xanthoides*, L.)

Order *Compositae*.

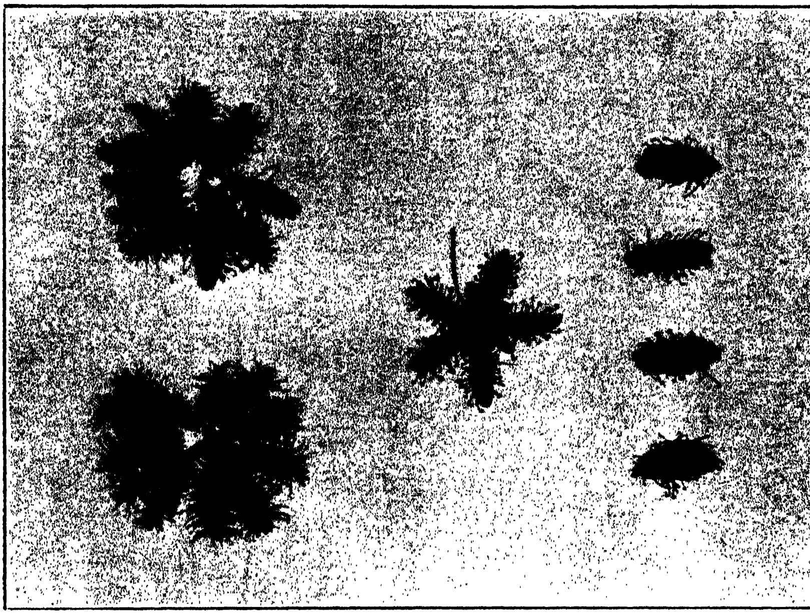
THE "Prostrate Star-bur" botanically known as *Acanthospermum xanthoides*, L., is a native of South and tropical America. It is a weed of recent appearance in this country and has only been recorded during the last ten years. It is frequently found on waste lands, along roadsides and water-courses, and is sometimes found in cultivated lands. It is a troublesome weed to sheep farmers on account of its "burs."

The "bur" is one-seeded, $^1/_8$-$\frac{1}{4}$ inch long, oblong in shape, ridged, and with the ridges covered with hooked spines. It differs from the "bur" of the "Upright Star-bur" (*Acanthospermum hispidum*, L.) by the absence of the two long hooked spines at the apex. (Plate I.)

The "burs" may be disseminated in various ways, e.g.:—

(1) As the plants grow along water-courses and roadsides, where stock pass to and fro, the "burs" adhere to the hair and wool of animals, and may be carried long distances before they are rubbed off.

(2) The "burs" are also harvested with fodder and so distributed in "foodstuffs."



[*Photos by H. King.*

PLATE I.—Variation of "Burs," *Acanthospermum xanthoides*, L.

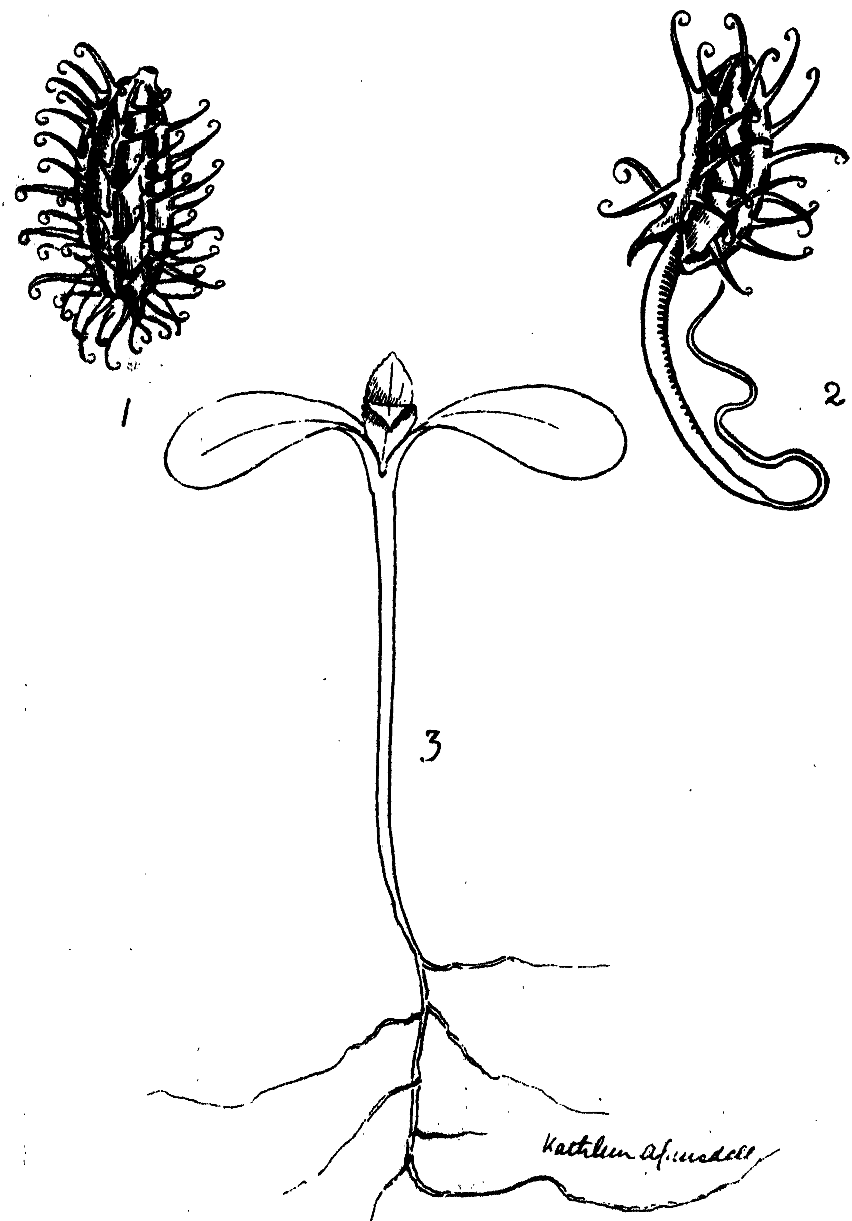


PLATE II.—Prostrate Star-bur, *Acanthospermum xanthoides*, L. Fig. 1.—"Bur." Fig. 2.—"Bur," showing radicle 19 days after sowing. Fig. 3.—Seedling, 4 weeks after sowing.

(3) They are carried down streams by flood waters and deposited by the river banks, where they germinate and form new infected areas.

The germinating capacity of the seeds has been tested with the following results:—

Number of seeds planted.	Date planted.	Radicle appeared.	Cotyledon appeared.	Germinating capacity.
100	20th July, 1920.	9th August, 1920.	15th August, 1920.	89 per cent.

The "burs" were planted in damp sawdust on the 20th July, 1920. The radicles began to appear on the 9th of August, i.e. nineteen days after planting (Plate II, Fig. I), and the cotyledons six days later. The coyledons are pale green, about ¼ inch long, spatulate, and smooth (Plate II, Fig. III). The plumule appeared two days later than the cotyledons and the first leaves were produced six days later; the latter are oblong, veined, and toothed along the margin. (Plate II, Fig. III.)

The seedlings were planted out and grew rapidly into the adult plant which flower and set "burs" two or three times during the year. In winter the plants are frosted down and only the bare brown stems are seen lying on the ground resembling dead twigs. One plant produces from 500-3,000 "burs" during the year.

An examination of specimens received from various localities shows that there is a local variation in habit. At first it was suspected that these forms belonged to different species, but a comparison of the specimens with the named specimens at the Kew Herbarium, kindly undertaken by the Director of Kew, did not confirm this, so that the different specimens must be regarded as local variations. The variations observed are, however, constant characters as was proved by experiments. "Burs" from different localities and gathered from plants showing variation were planted in the same plot of ground at the Division of Botany. The seedlings were all carefully examined and showed the same variations as those of the parent plant. It is evident, therefore, that the variations exhibited by the parents were not due to local climatic or soil conditions (Plate VI).

The following table shows the variations noted:—

	Plant I (Plate III and VI.)	Plant II (Plates IV and VI.)
Stem ...	With a thick hairy covering, soft to the touch	With minute stiff hairs, rough to the touch.
Leaves ...	Large, ovate, with wavy margins, pubescent, dull grey-green in colour	Small, ovate, spatulate, with serrate margins, shining, bright green in colour.
"Burs" ...	5–15 in each cluster, thickly spined	4–6 in each cluster, sparsely spined.

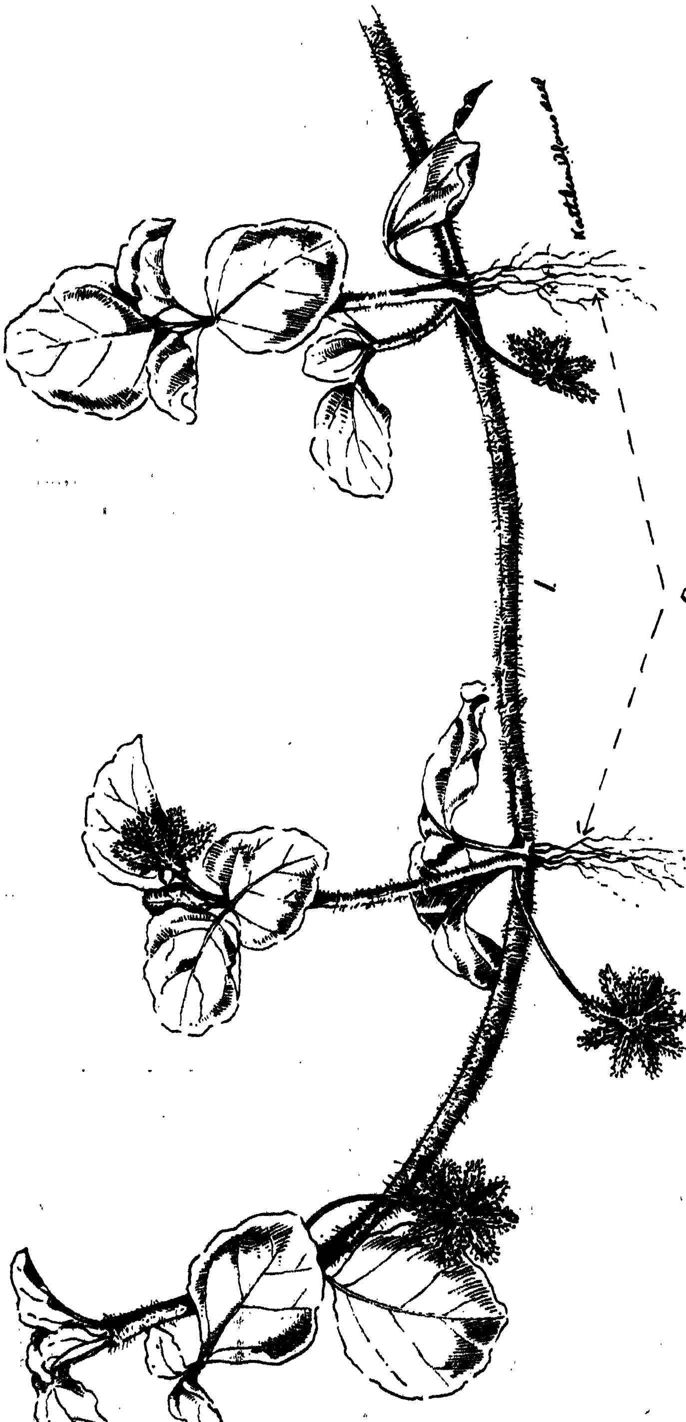


PLATE III.—THE NATAL PLANT.
The Prostrate Star-bur, *Acanthospermum xanthoides.* Portion of Plant.

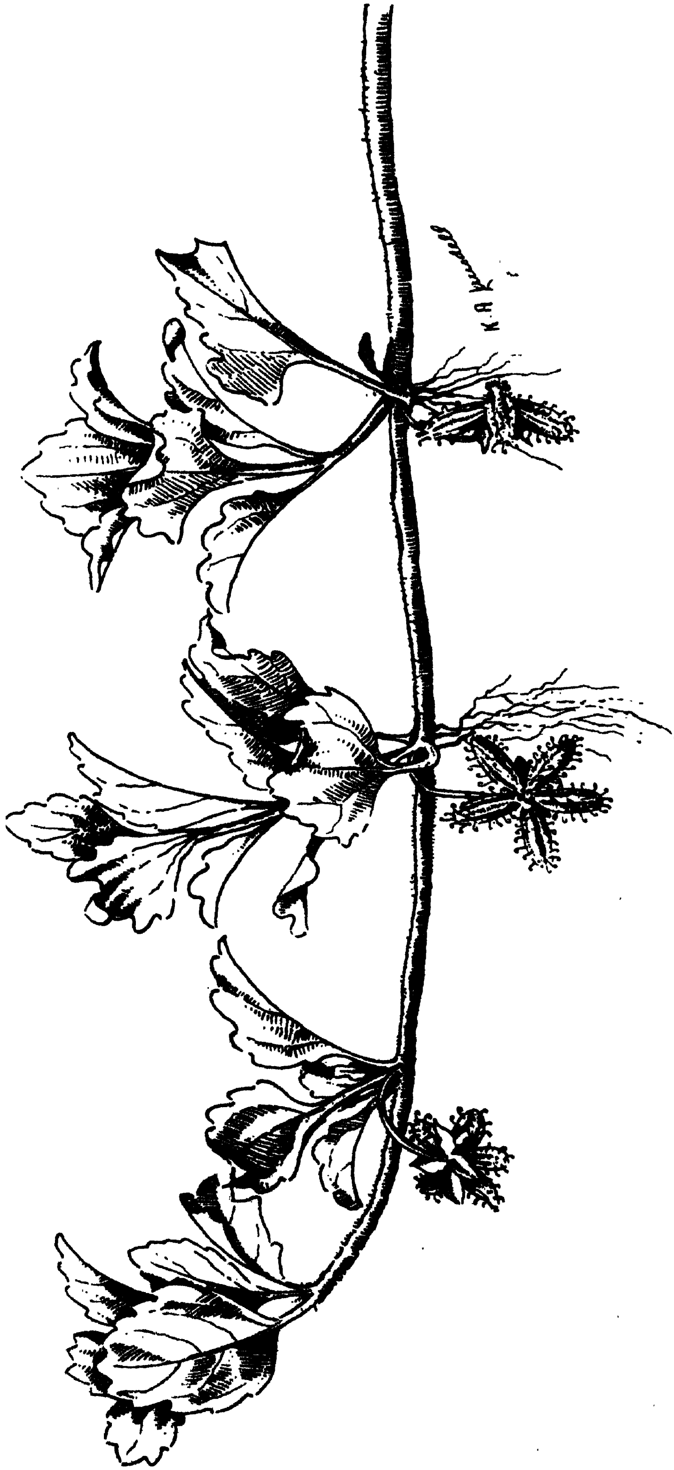
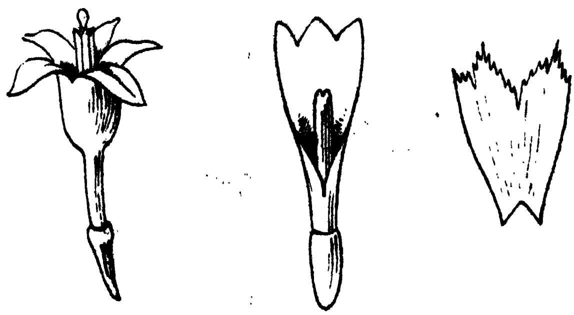


Plate IV.—Transvaal Plant.

Prostrate Star-bur, *Acanthospermum xanthoides*. Portion of Plant.

The plant is a prostrate spreading creeping perennial, rarely more than two-six inches high. (Plate VI.) It has a long tap-root and the creeping stems give rise to adventitious roots which enable the plant to get a firm grip on the ground (Plate VI).

The leaves are bright or dull green in colour, stalked, opposite, ovate, or spatulate, toothed or wavy along the margin. The flower



K. A. LANSDELL.

1. 2. 3.

PLATE V. Fig. 1.—Female floret. Fig. 2. Male floret. Fig. 3.—Ciliated bract.

PLATE VI.—Plants of Prostrate Star-bur.

head contains both male and female flowers (Plate V) which are borne on stalks in the axils of the branches. The male flowers are tubular and at the base of each floret is a ciliated bract. (Plate V.) The female flowers surround the male and later grow into "burs" which are arranged in groups of 3-15 and radiate outwards, giving the whole inflorescence a "star-like" appearance.

Eradication.—Hand hoeing appears to be the only satisfactory method of eradication, but care must be taken to get all branches with adventitious root as well. Never allow plants to set "burs" (see "**Eradication of Weeds,**" *Journal of Agriculture*, Union of South **Africa,** Vol. III., Nov., 1921, p. 456). The "Prostrate **Star-bur**" is a proclaimed noxious weed under *Acanthospermum* spp. throughout the Transvaal and Natal Provinces (at date of publication).

Summary of information, for use in the recognition of the weed, dissemination, and eradication:—

Vernacular name ...	Prostrate Star-bur.
Scientific name ...	*Acanthospermum xanthoides*, L.
Duration	Perennial.
Flower	Minute, whitish, in clusters in the axils of the branches.
Leaf...	Light and dull green in colour, smooth and hairy, varying in shape.
Achene	A "bur" covered with hooked spines.
Habitat	Roadsides, water-courses, cultivated lands.
Dissemination ...	Animals, flood waters, fodder.
Eradication... ...	See "Eradication of Weeds," *Journal of Agriculture*, Union of South Africa, Vol. III, November 1921, p. 456.

Nurseries in Quarantine at the 1st October, 1925.

Name.	Address.	Cause of Quarantine.	Extent of Quarantine.
Distributors Co., Craighall Nursery	Craighall, Johannesburg	Crown-gall and Root-gall Worm	Deciduous, all.
Sunnyside Nursery ...	Louis Trichardt ...	Red Scale ...	Citrus, all.
D. J. Conradie & Bros.	Robertson, C.P. ...	Red Scale ...	Citrus, all.
A. S. Strydom & Co. ...	Krakeel River ...	Woolly Aphis ...	Deciduous, part.
G. J. Labuschagne ...	Groot Marico ...	Red Scale ...	Citrus, all.
Distributors Co., Craighall Nursery	Craighall, Johannesburg	Pernicious Scale...	Deciduous, part.

IRRIGATION, WITH SPECIAL REFERENCE TO THE ECONOMIC USE OF WATER.

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IN most countries, particularly America, Australia, Asia, and Africa, we find that the proportion of arid and semi-arid to humid land is very large, so large in fact, that there is no possibility of reclaiming a great proportion of the arid areas for profitable crop production, even should every possible use be made of all water available.

When we examine a map of the Union of South Africa showing the average annual precipitation we are struck by the fact that approximately one half of this country is arid and semi-arid, or roughly an area of 150,000,000 acres.

The statistics available in connexion with land irrigated, and that which falls under schemes in the course of construction, show that about 1,000,000 acres of land is receiving or will shortly receive benefit from the application of irrigation water, while an additional area of about 500,000 acres may, at some later date, be brought under irrigation.

This means that only about 1 per cent. of the arid and semi-arid area of the Union can be irrigated.

It is, of course, hardly necessary to state that only a small portion of the arid regions of the country is suitable for crop growth, owing to the nature of the soil and the large area occupied by hills and mountains. But even if we take it that a quarter of the arid and semi-arid regions have the right aspect and the soil suitable for the production of crops under irrigation, we still find that only about 4 or 5 per cent. of that vast area can be reclaimed for crop production.

It follows that, as the water and not the quantity of land is the factor that limits the area which can ultimately be brought under cultivation in the dry regions, we should make every endeavour to obtain the largest return of crops from each unit of water. In this way only can the water available be made to give the maximum return.

It may not always be most economical to use the least quantity of water that will keep a crop alive, and then again, what may be most economical for one crop, or under one set of conditions, may not be best for other crops or other conditions.

It is essential, therefore, that the irrigation farmer should understand the various factors that affect the response of a crop to irrigation water and the relationship between the soil and the water applied.

Such knowledge is acquired by the farmer sometimes only after very costly experience, but if our Experiment Stations were in a position to give the necessary information, our farmers might be saved a considerable amount of worry. Unfortunately, the Experiment Stations in the Union are relatively young institutions, and data are as yet not forthcoming in so far as irrigation is concerned. The experiments now under way at Grootfontein will no doubt furnish valuable information to the farmer in a few years' time. In the meantime, if we are to advise the farmer with regard to irrigation problems, it is necessary to consult the data of foreign countries.

In this paper free use has been made of figures obtained under conditions in America, similar in many ways to our Karroo area particularly, so that it is felt that conclusions drawn from these data may be applicable in some degree to the elevated, dry areas of the Union.

It is necessary, however, before we discuss individual crops under irrigation, that we should consider the effect of irrigation on those factors that are so intimately connected with crop growth.

THE RELATIONSHIP BETWEEN WATER AND FACTORS ESSENTIAL TO PLANT GROWTH.

In order that crops may grow it is essential that they be provided with sufficient water, plant food, air, light, also a suitable temperature. It is, of course, necessary that there should be no injurious substance in the soil. That irrigation water does affect these factors in plant growth may not be well known to farmers, so that a short review of the subject is necessary at this point.

WATER AND SOIL RELATIONSHIPS.

Most of our arid soils are largely composed of partly decomposed rock powder. This is due to the fact that there has been insufficient moisture to bring about the decomposition of the rock particles. When irrigation water is applied to such soils it will be found that there is a tendency for the rock particles to be broken down. This may be illustrated by the action of water on rock particles derived from the dolerite hills found so largely in the Karroo area. These dolerites are composed mostly of soda lime feldspars which, in the presence of water and carbon dioxide, are broken down into lime, sodium carbonate, and clay. We are all familiar with the large amount of lime found in our red Karroo soils. The tendency, therefore, when we apply water to such soils, is to fine down the soil and make it more impervious to water and air. The sodium carbonate has a tendency to deflocculate the aggregates of soil particles (crumbs) and in that way to render the soil very impervious.

It will be realized, then, that irrigation water may have a very marked effect on an essential factor in plant growth, namely, the air in the soil. When soil becomes relatively impervious there is only a slow exchange between the air of the soil and that of the atmosphere above, with the result that there is not enough oxygen for proper root development, and apart from that the oxygen

necessary for those soil organisms that break down organic matter and make plant food available will be limited, and so another factor in plant growth, namely, plant food, may be reduced. Then again it is found that certain injurious organisms thrive in poorly aerated soils. These organisms reduce oxidized compounds, with the result that injurious reduction products are formed.

It will be abundantly clear from the foregoing that maintenance of a friable, pervious condition of the soil is of considerable importance under irrigation.

Another point to consider in this connexion is the tendency of water to break down the crumb structure of the soil. A soil in good tilth is composed of little clusters of soil particles which give to the soil a loose, open structure, thereby permitting of the ready penetration of roots deep into the soil, of good aeration and the rapid passage of water into the soil. It will be found that water standing for some time on the soil (the result of heavy irrigation) tends to break down these crumbs into their constituent small particles which tend to pack closer together and make the soil relatively impervious. This, in turn, prevents irrigation water from penetrating quickly into the soil when irrigated later, for the air cannot pass out of the impervious soil at a rate fast enough to permit of the rapid entrance of water. The condition of the soil goes, therefore, from bad to worse.

In the event of there being sodium carbonate in the irrigation water or in the soil, the breaking down of the crumbs (deflocculation) proceeds much faster and the soil will become almost useless owing to the poor tilth and lack of sufficient air. Such soils on drying out are very cloddy and difficult to work.

The effect of sodium carbonate in the irrigation water has been indicated above. It must be emphasized that the irrigation water used has a great deal to do with the success or failure of irrigated lands.

The waters used for irrigation in the arid areas very frequently contain salts in solution. This is due to the fact that the soluble salts formed in the soils of dry regions are not leached out to the same extent as they are in humid parts, due, of course, to the very low rainfall.

Some of these salts have very little effect on the soil when irrigation water containing them in solution is used, provided they are not present in large quantities. Irrigation waters may be divided roughly into the following groups:—

(*a*) Brak with or without sodium carbonate.

(*b*) Non-brak with or without suspended matter.

Brak waters (excluding sodium carbonate), provided the concentration of salts is not so high as to be injurious to crops, may be used for irrigation purposes if a few precautions be taken.

In the first place the drainage of the soil must be good if brak waters are to be used, the object being to prevent an accumulation of water in the soil, which might later rise to the surface by capillarity, there to be evaporated, with the result that brak salts become deposited at the surface of the soil and ultimately injure crops.

In view of the fact that there is always a tendency for waters to rise by capillarity to the surface there to be evaporated, it is especially desirable when using brak water to check evaporation as much as possible. Evaporation may be prevented by growing crops that will shade the soil or by cultivation. For this reason we find that a crop like lucerne is better adapted to the use of brak water than some other crops. If brak water be used in crops that are planted in rows, then every care should be taken to check evaporation by cultivation.

It is an established fact that evaporation is very great from a soil that is kept constantly moist at the surface. Where brak waters are used heavy irrigations at long intervals are preferable to frequent light irrigations.

Waters that are charged with sodium carbonate must be used with great discretion on account not only of the deflocculatory effect of these waters, but also because of the tendency of sodium carbonate, when in sufficiently high concentration, to injure the roots of the plant, and to dissolve the organic matter in the soil. It is safe to say that water containing sodium carbonate should never be used on heavy soils, but it may be used if absolutely necessary on light sandy soils, provided an attempt be made to neutralize the effect of the sodium carbonate by the application of gypsum to the soil. The gypsum reacts with the sodium carbonate, forming lime and relatively harmless sodium sulphate.

As a general rule, brak waters that contain no sodium carbonate will contain little suspended matter in the form of clay or silt, as the brak salts tend to flocculate these particles. Sodium carbonate waters, on the other hand, are usually very muddy, as the tendency is for the clay and silt to be kept in suspension owing to the deflocculating action of the sodium carbonate. This means that very muddy waters must be looked upon with suspicion until it can be determined by analysis that no soda is present. Such muddy waters that contain no soda may be used on all lands and are rather beneficial to light open soils, as they tend to bind these soils and increase the water-holding capacity. Care should be taken, after using muddy waters, to break the crust which is left on the land in order to permit of the entrance of air into the soil. This crust is sometimes very impervious, with the result that damage may be done to young plants particularly, if no measures are taken to break it up by harrowing shortly after watering.

Because water may contain no brak it is no reason for the use of excessive quantities of water, nor is there any reason why drainage and evaporation should not be considered where a pure water is available for irrigation purposes. All arid soils contain a considerable amount of soluble matter which will pass into solution in the soil water. If evaporation is not checked this soluble matter will accumulate at the surface until in time crop growth will be inhibited. The rate at which these salts accumulate at the surface will depend on the quantity of water and the drainage. If the drainage is poor the water will accumulate in the subsoil and gradually rise until moisture connexion between the surface and the sub-soil water is established, when evaporation will proceed apace and a great deal of brak will be deposited at the surface. Such salts will ultimately harm the crops.

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From the foregoing it may be seen that the careless use of water may affect the essential factors in plant growth and result in the prevention of crop growth in a soil at one time perhaps remarkably productive.

THE METHOD OF APPLYING WATER.

Closely connected with the effect of water on the soil is the method of applying the water, for it must be apparent that the system of flooding or furrow irrigation will affect somewhat differently the evaporation of water from the soil and the physical properties of the soil.

The ideal system of irrigation is one that approaches most nearly to a light shower of rain, where every drop soaks into the soil without at any time completely saturating any portion of the soil and without leaving water standing on the surface. Such an ideal cannot be attained in practice excepting in a few places where intensive vegetable culture is gone in for and where an expensive sprinkling system can profitably be employed.

The two main systems in practice are the furrow and the flooding methods with, of course, modifications of these.

The furrow method consists in allowing the water to flow down furrows drawn at intervals (depending on the nature of the soil) between the crop. This system is used where water is scarce, and the largest possible area is to be irrigated (economically) with a given quantity of water. The method has many advantages of which the chief are the use of light irrigations, the reduction of the loss by evaporation, and consequently less danger of brak, the maintenance of a good physical condition (crumb structure), and the greater aeration of the soil possible under this system.

The furrow method lends itself to use particularly in the irrigation of crops planted in rows and also those crops that may not shade the ground satisfactorily. The method is almost essential in the case of a crop such as the potato which requires an open friable soil for the tubers to develop satisfactorily.

The flooding method, of course, has the advantage that it simplifies the work in connexion with water leading and although what are advantages in the case of the furrow system are not such in this method, still we find that some crops can be irrigated with advantage by flooding.

Such crops are perennials that shade the ground and can be severely cultivated during the dormant season, and annual crops that are planted broadcast or by means of a grain drill, which shade the ground and prevent evaporation, at any rate from the time they receive the first irrigation after planting. Examples of these groups are lucerne and winter cereals respectively.

Before considering crop and water relationship it would be as well to touch very briefly on some factors which may affect the economic use, or otherwise, of water.

It is well known that animals that are in a thrifty condition make better use of their food than those that are unthrifty—similarly with plants. This thrifty condition in plants will be found only when all factors contributing to crop growth are favourable. It can be understood, therefore, that maximum economy in the use of irrigation water will be attained when crops are vigorous.

SOIL FERTILITY.

Soil fertility is an important factor in this connexion. It will be found that crops growing on a fertile soil will make more economical use of water than those on poor soils. This does not mean that the crops will use less water in the former case, but it means that for every pound of dry weight produced less water will be required and as crops on rich give larger yields than those on poor soils the total quantity of water required for the crop in the former case may be greater. (See Table I.)

TABLE I.

*Effect of Fertile and Infertile Soil, Manured and Unmanured, on Water Requirements.**

	Unmanured.	Manured.	
Infertile	463	323	lb. water for 1 lb. dry matter.
Intermediate	384	308	
Fertile	327	298	

SOIL DEPTH.

Closely connected with soil fertility is the depth of the soil. Deep soils will be able to take up and hold larger quantities of water than shallow soils, which means that less frequent irrigations will be required. There will be less chance for brak to rise, owing to the reduction in evaporation at the surface as a result of the waterings at long intervals whereby the surface soil will be less often moist. The deep soil will enable the plant roots to penetrate into a larger area of soil from which greater quantities of plant food and water may be drawn. This makes for thrifty growth and the economic use of water.

SOIL SATURATION.

The degree of soil saturation may not be thought to have any great effect on the vigour of plant growth, and yet this is a factor of considerable importance, for it must be remembered that water takes the place of air in the soil and when the content of water is high it follows that the air in the soil will be correspondingly low. The importance of air has already been emphasized, but apart from this wet soils are cold soils, and evaporation is great from a soil kept constantly wet.

Experiments have shown that most vigorous crop growth is found in soils having 50 to 60 per cent. of their maximum capacity for water satisfied. In terms of volume this represents about 16 per cent. for average soils or an equivalent of 2 inches of water per foot (depth). The amount of water present in the soil at the time when plants wilt from lack of water is about 1 inch, roughly, per foot. It must be clear, therefore, that to bring a soil to optimum moisture after the plant shows signs of wilting will take about 1 inch per foot (depth). In table II will be observed the effect of degree of soil saturation on the use of water by maize.

* Nebraska Research Bulletin, No. 6, p. 151, 1916.

TABLE II.

*Effect of Relative Saturation on Water Requirements of Maize.**

Per Cent. Saturation.	Lb. of Water for 1 lb. Dry Matter.
49	293
73	317
97	343

Although about 1 inch of water per foot is approximately the quantity required per irrigation to bring soil to optimum moisture-content from the point at which the crop shows signs of wilting, it must be evident that slightly more than this quantity will be required in practice, as otherwise irrigations will have to be too frequent on shallow soils. On deep soils, particularly those that are heavy, the quantity of water per irrigation should be so regulated as to prevent water standing in the soil for a considerable time (thereby deflocculating the soil) and also to prevent water from draining away from the root zone in well drained soils. On shallow soils, say, two feet deep, we may take it that water at the rate of about 1½ inch per foot will be ample. This would mean three inches per application. On a soil six feet deep, one inch per foot, making six inches per irrigation, would be about the maximum. In the latter case water would naturally need to be applied half as frequently as in the former. If larger quantities than six inches of water were applied there is the danger of loss by seepage and the injurious effect of standing water on soil structure.

SOIL CULTIVATION.

The intervals between the irrigations will vary depending on a number of factors, one of the most important, in the case of crops planted in rows particularly, being cultivation. The need for cultivation is appreciated by farmers who are dependent for crop growth on rainfall. The irrigation farmer, however, because he has some measure of control over his water supply, may not cultivate at all. Under irrigation, cultivation is of importance because it checks evaporation and thereby prevents very largely the rise of brak to the surface. Apart from this the constant irrigation of sorts, particularly by the flooding system, tends to pack the soil and prevents aeration and the ready penetration of water. This aeration is beneficial to organisms that help in the liberation of plant food. It should also be pointed out that cultivation destroys weeds which compete with the crop not only for plant food, but also for water. Cultivation makes, therefore, for thrifty growth of the crop by reducing competition, by liberating plant food, and by preventing the rise of harmful brak through the reduction of evaporation. As a result we get water used economically.

In connexion with cultivation, the point should be stressed that once the surface soil has been loosened after irrigation and the weeds destroyed, no good purpose will be served by further cultivations.

* Nebraska Research Bulletin, No. 6, p. 138, 1916.

The effect of cultivation on the water requirements of crops is well illustrated in Table III.

TABLE III.

*Effect of Cultivation on Water Requirements of Maize.**

Nature of Cultivation.	Lb. of Water for 1 lb. Dry Matter.
(1) 74 hours after irrigation, then weekly... ...	252
None	603
(.) . 48 hours after irrigation, then weekly... ...	428
None	535

REQUIREMENTS OF INDIVIDUAL CROPS FOR WATER.

In a paper such as this it is quite impossible to cover the relationship between all field crops and irrigation water. It is felt that it will be sufficient if individuals be chosen that are representative of different groups.

LUCERNE.

The first crop that will be considered is lucerne, as this is not only the outstanding example of the group of hay crops, but it is also a crop grown practically in every locality where crops are irrigated.

The hay crops as a group are characterized usually by their rather high water cost of dry matter as compared with grain crops. They are able also to make use of large quantities of water more successfully than other groups.

Method of Irrigation.—In the preceding discussion it has been pointed out that lucerne may be irrigated by the flooding method, as it is a crop which prevents evaporation and may be very severely cultivated in the dormant season to loosen and aerate the soil. The presence of furrows in a lucerne land adds considerably to the difficulty of mowing, and apart from that the furrows soon become choked with the stems of lucerne and weeds and in consequence may not be effective for long. Where lucerne is grown in the humid areas under irrigation it may be found convenient to use the furrow method as the lucerne is frequently planted in rows in order that weeds may be controlled. In general, it is felt that flooding is a convenient method and usually the one more desirable. Flooding, of course, is the only method possible on those farms where the tremendous streams of flood water (following heavy rains) are diverted on to lucerne lands.

Quantity of Water per Application.—Lucerne is a crop that can stand heavy applications of water provided the soil is not so impervious as to cause water to stand on the land too long, for it has been found that lucerne plants may be destroyed by being submerged for only 24 hours. The actual quantity per application will vary with the depth of the soil as previously explained. It is doubtful, however, where lucerne is growing in exceedingly deep soil, whether it

* Utah Bulletin, No. 105, p. 19. 1909.

will be advisable ever to make heavier applications than six inches at a time in view of the packing that would follow such waterings and in view also of the fact that a considerable loss by seepage may take place. Apart from this it will be found, as will be seen later, that a reasonable irrigation over a larger area will be much more satisfactory from the point of view of yield than larger quantities on smaller areas.

Stage to Irrigate.—There would appear to be some difference of opinion as to whether better results will be obtained by irrigations shortly before or shortly after cutting lucerne. Experimental data, as will be seen from Table IV, do not seem to show any advantage for either the one or the other.

TABLE IV.

*Effect of Time of Application on Yield of Lucerne.**

Time.	Yield per Acre.
Just before cutting and 15 days later	10,198
Just after cutting and 15 days later	10,135

It would appear that there are more advantages in applying water shortly before mowing. In the first place there will be somewhat less evaporation of water from the land irrigated before cutting, then again there is the tendency of the crop to start growth immediately after cutting, as the soil will be fairly moist. Where water is applied after mowing it is necessary to delay the irrigation until after hay-making operations have been completed. Consequently, as the soil remains dry for perhaps four or five days after cutting, there is a less rapid response by the new crop. This may be a point of relatively little importance in the case of a slow starting variety such as Provence, but with varieties such as Chinese and Hunter's River which commence growth almost at once after cutting it is felt that the irrigation before cutting has some advantage. A further consideration is this: In dry areas it frequently happens that the hay drys out so quickly after mowing that a very great loss of leaves takes place. If the soil is relatively moist at the time of mowing it is probable that the lucerne will dry out more slowly, and consequently the leaves will not be lost to the same extent as in the case of watering after mowing. The presence of more leaves in the hay makes for better quality and feeding value.

Condition of Crop at time of Irrigation.—Once lucerne has become badly wilted owing to lack of water, it will be found that the watering of the crop does not result in recovery of the wilted shoots. What happens is that new growth starts from the base of the plant. It is advisable, therefore, not to withhold water until wilting becomes pronounced, but it would appear that better returns per inch of irrigation water are obtained when watering is delayed until the crop shows signs of needing water by becoming slightly wilted in the morning.

* Utah Bulletin, No. 118, p. 140, 1912.

TABLE V.

*Effect of Condition of Crop at Time of Irrigation and Amount of Water per Application on Yield of Lucerne.**

Water Retained in 4 ft. Soil.	Depth per Application.	Number of Applications.	Stage of Growth.	Yield per Acre.	Yield per Foot of Water.	Per Cent. Leaves.
Per Cent.	Inches.			Tons.		
50	6	11	(1) Before plants show need of water	6·0	1·21	36·45
70	6	7	(2) Plants dark green colour ...	5·59	1·67	40·20
75	6	3	(3) Leaves beginning to droop...	4·08	2·23	42·27
28	9	7	As (1) above	5·81	1·18	35·9
51	9	5	As (2) above	5·45	1·61	40·5
56	9	3	As (3) above	4·42	1·78	41·4
25	12	7	As (1) above	6·18	1·03	37·38
33·7	12	5	As (2) above	5·43	1·57	38·49
45	12	3	As (3) above	4·86	1·93	38·55

It will be noticed from the table that six-inch irrigations applied at the time when the leaves first started to droop gave highest returns per unit of water, also the greatest percentage of leaves, and resulted in least loss of water by percolation.

Quantity of Water per Season.—With most crops it will be found that the yield per acre can be increased by increasing the quantity of water, but it frequently happens that a point is reached where further additions of water result in no more response on the part of the crop, while in some cases a reduction in yield may take place owing to the excessive quantity of water in the soil, making conditions unfavourable to the crop. In all cases, however, it will be found that while the yield per acre varies directly with the quantity of water applied, yet the yield per unit of water almost always varies in an inverse ratio.

The effect of heavy and light irrigations on lucerne are well illustrated in Tables VI and VII.

TABLE VI.

Effect of Quantity of Water per Season on Lucerne.†

Quantity.	Yield per Acre.	Yield per Inch of Water.
	lb.	lb.
6	9,220	1,537
12	8,840	737
18	7,500	416
24	12,700	529
30	14,400	480
36	15,360	426

* Nevada Bulletin, No. 96, p. 21, 1919.
† J. A. Widtsoe in "Principles of Irrigation Practice," p. 274, 1914.

TABLE VII.

*Effect of the Quantity of Water per Acre on Yield of Lucerne.**

	Thirty Acre Inches Spread over.		
	One Acre, 30 Inches Deep.	Two Acres, 15 Inches Deep.	Three Acres 10 Inches Deep.
Yield, Hay	8,840	15,095	29,653

It is difficult to indicate precisely what quantity of water will be most economical as this will depend on the quantity of water available, the amount of land suitable for irrigation, and the cost of preparing the land for lucerne. Where land is scarce and water abundant it may pay for a time to secure the maximum yield per acre, while with restricted quantities of water and a large area of good soil, the highest yield per unit of water should in most cases be more profitable. It is safe to say that in the latter case there will be practically no danger of ruining the soil, while in the former the danger will be great.

Winter Irrigation.—Although lucerne varieties are for the most part relatively dormant during the winter, yet it will be found that lucerne lands kept relatively moist during the winter will give a certain amount of growth and will be less liable to winter kill. While it is not a very good practice to graze lucerne heavily, still a considerable amount of green feed can be obtained for winter grazing in lucerne lands, and this grazing will have little injurious effect provided it is done with moderation. As a matter of fact, grazing is the only means of utilizing the growth made by lucerne during the winter. It might be mentioned in passing that the best use to which lucerne lands can be put in winter is to sow them with some winter cereal, such as rye, during the autumn for the purpose of providing a very useful mixed green feed in winter.

Irrigation of Young Lucerne.—The best way to establish lucerne is to sow shortly after the soil has been irrigated and then to withhold the first irrigation until the young plant is absolutely in need of water. This encourages a deep root system. Irrigation immediately after sowing is to be discouraged, as it tends to pack the soil, encourages loss of water by evaporation, and usually results in more frequent irrigations being required during the early life of the crop.

WINTER CEREALS.

Although the cultivation of winter cereals under irrigation for the production of grain is a very questionable one from the economic point of view, yet it is so commonly done that it would be well for the farmers to have some idea of the requirements of one of these crops at least. As an example of this group, wheat will be taken.

IRRIGATION OF WHEAT.

Method.—The method usually employed for this crop is the flood system, for the reason that the method is simple and facilitates harvesting where machinery is used. As the sowing is usually done

* Utah Bulletin, No. 117, p. 100, 1912.

after the soil has been irrigated (the most desirable practice for the same reasons as those given for lucerne) and the land is harrowed after seeding, very little evaporation takes place during the early stages of growth owing to the loose surface mulch. The first irrigation being usually delayed until the plants more or less completely shade the ground also results in a reduction in the amount of water lost by evaporation. It has been shown by experiments that evaporation from the soil, once the wheat crop shades the ground, is practically negligible.

Quantity of Water per Irrigation.—This will depend, as already pointed out, largely on the depth of the soil. In view of the fact, however, that wheat roots are relatively shallow, it is even of more importance not to apply too heavy an application at a time for fear lest the water pass beyond the root zone. It is infinitely more desirable, of course, to give fairly heavy irrigations at long intervals than frequent light waterings, not only to reduce cost of labour, but also to reduce loss of water by evaporation. It is doubtful if one should ever use more than five or six inches at one application. The figures shown in Table V will be of interest in this connexion in that they show the very large amount of water lost by percolation beyond the four-foot zone in lands receiving six, nine, and twelve inch irrigations.

Stage at which to Irrigate.—A large number of data is available in connexion with the stages in the growth of wheat at which irrigation water should be applied. There seems to be little question that the first irrigation should be withheld until the crop has become thoroughly established and is about five or six inches high, or is in the so-called "five-leaf" stage. It would appear that this is a critical period in the growth of the crop. Water withheld at this stage usually results in a reduction in yield. Other important stages are "boot" and "bloom."

The figures given in Table VIII should prove of interest.

TABLE VIII.

*Effect of Stage of Growth at time of Irrigation on Yield of Wheat.**

Treatment.	Yield.	Treatment.	Yield.
	Bushels.		Bushels.
1 in. weekly = 9 in. ...	44·5	10 in. at boot and bloom ...	39·1
2½ in. „ = 22½ in. ...	44·6	10 in. at bloom and dough ...	39·5
5 in. „ = 45 in. ...	45·8	10 in. at 5-leaf and dough ...	43·4
7½ in. „ = 67½ in. ...	43·5	10 in. at 5-leaf and bloom ...	45·1
5 in. before plants up ...	29·7	20 in. at all stages	45·7
5 in. at 5-leaf	40·8	15 in. at boot, bloom, and dough	46·7
5 in. at boot	39·1	15 in. at 5-leaf, „ „	48·3
5 in. at bloom	38·2	15 in. at 5-leaf, boot, „	47·8
5 in. at dough	36·7	15 in. at 5-leaf, boot, and bloom	52·4
10 in. at 5-leaf and boot ...	44·6		

Summary of Best Stages with given Quantity of Water.

15 in. at 5-leaf, boot, bloom...	52·4 bushels.	5 in. at 5-leaf	40·8 bushels.
10 in. at 5-leaf, bloom ...	45·1 „	9 in. 1 inch weekly	44·3 „

* Utah Bulletin, No. 146, p. 30, 1916.

It will be abundantly clear from these data that the stage at which wheat is irrigated will leave a marked effect on the yield. It is also evident that, provided the irrigation be given at the right time, light waterings per season will give almost as satisfactory returns as much heavier ones. The most unsatisfactory results follow an irrigation immediately after sowing.

Quantity of Water per Season.—Tables VIII, IX, and X show that wheat is one of those crops that can be brought to maturity with very light irrigations and this is especially true when the irrigations coincide with the stages which respond best.

TABLE IX.

*Yield of Wheat as affected by Quantity of Water per Season.**

Water per Acre in Inches.	Yield in Bushels per Acre.	Yield per Inch of Water.
5·0	37·81	7·56
7·5	41·5	6·39
10·0	43·5	4·35
15·0	45·7	3·05
25·0	46·5	1·86
35·0	48·6	1·39
50·0	49·4	0·99

TABLE X.

Effect of Quantity per Acre on Yield of Wheat from given Amount of Water.†

	Thirty Inches Spread over.				
	One Acre, 30 Inches Deep.	Two Acres, 15 Inches Deep.	Three Acres, 10 Inches Deep.	Four Acres, 7·5 Inches Deep.	Six Acres, 5 Inches Deep.
Yield, Bushels ...	47·5	91·4	130·6	166·2	226·9

If those farmers who grow wheat under irrigation, for the production of grain, would realize with what small quantities of water a wheat crop can be produced, they would undoubtedly have a much better chance of growing the crop profitably than they have at present.

SUMMER CEREALS.

Another group of crops that is sometimes grown under irrigation for the production of grain is the summer cereals, of which maize may be taken as an example. It is, of course, very questionable whether this crop can be grown at a profit under irrigation, because its demands for water coincide with the period when water will be required for lucerne, which is a more profitable crop under irrigation. Winter cereals are fortunate in that they need water very largely during the period when lucerne can do with little.

* Utah Bulletin, No. 117, p. 77, 1912.
† Utah Bulletin, No. 117, p. 80, 1912.

MAIZE.

Method of Irrigation.—Little difference has been found between the furrow and the flood methods of irrigating maize, and no doubt this is due to the fact that the crop is one which can be cultivated, thus evaporation can be checked and the soil aerated. Under conditions where the soil can readily be levelled the flooding system has the advantage in that it is convenient and, apart from this, facilitates harvesting the whole crop (a practice very desirable). Where a small stream of water is available and it is not possible to make beds suitable for flooding purposes, the furrow method may conveniently be employed.

Quantity of Water per Irrigation.—It is not necessary to enlarge on what has been said in the case of wheat, as maize roots are confined to about the same area as those of wheat. The same recommendations will hold, therefore, for this crop. The injurious effect of heavy individual applications would be less marked in the case of maize as it would be possible to loosen the surface by cultivation. but the practice of giving heavy irrigations is not to be encouraged on account of the loss by seepage, unless, of course, it is desired to remove brak salts from the soil.

Stage at which to Irrigate.—The seed should be sown in soil that is well charged with moisture and the first irrigation delayed until the crop shows signs of needing water by a slight wilting of the leaves in the morning. Care should be taken however, not to delay this irrigation until the crop becomes badly wilted, as maize will not then recover satisfactorily. A critical stage in the life of maize is when pollination and fertilization take place. At this time there should be plenty of available moisture in the soil, for otherwise badly filled cobs will result. Finally, an irrigation at the time when the grain is in the milk stage will be necessary. A total of three good irrigations of, say, five inches each, during the growth of the crop should give satisfactory returns.

Quantity of Water per Season.—From Tables XI and XII it will be observed that excessive quantities of water per season have a marked effect on maize yield, so much so that reduction in yield may follow heavy seasonal irrigations.

TABLE XI.

*Effect of Quantity of Water on Yield of Maize.**

Water per Acre in Inches.	Yield in Bushels per Acre.	Yield per Inch of Water.
7·5	79·1	10·55
10·0	89·5	8·95
15·0	93·9	6·26
20·0	91·6	4·58
25·0	99·2	3·97
30·0	97·1	3·24
55·0	96·8	1·76

* Utah Bulletin, No. 117, p. 87, 1912.

TABLE XII.

Yield of Maize with a given Quantity of Water spread over one or more Acres.

	Thirty Inches Spread over.			
	One Acre, 30 Inches Deep.	Two Acres, 15 Inches Deep.	Three Acres. 10 Inches Deep.	Four Acres, 7·5 Inches Deep.
Yield, Bushels...	97·1	187·9	268·6	316·6

In this respect it may be stated that wheat will tolerate much larger quantities of water than maize, no doubt due to the fact that wheat will thrive on fairly compact soils, whereas maize is partial to open, well-drained, porous soils, well supplied with decomposing organic matter.

ROOT CROPS.

The last group of crops with which it is proposed to deal in this paper is the root crops, of which the potato has been selected as an example, although in some ways the potato may be classed by itself, in that it is particularly exacting in its water requirements.

THE POTATO.

Method.—On account of the method employed in the cultivation of the potato it is almost invariably irrigated by means of furrows. The flooding system should be discouraged as much as possible, because it has none of the advantages of the furrow method.

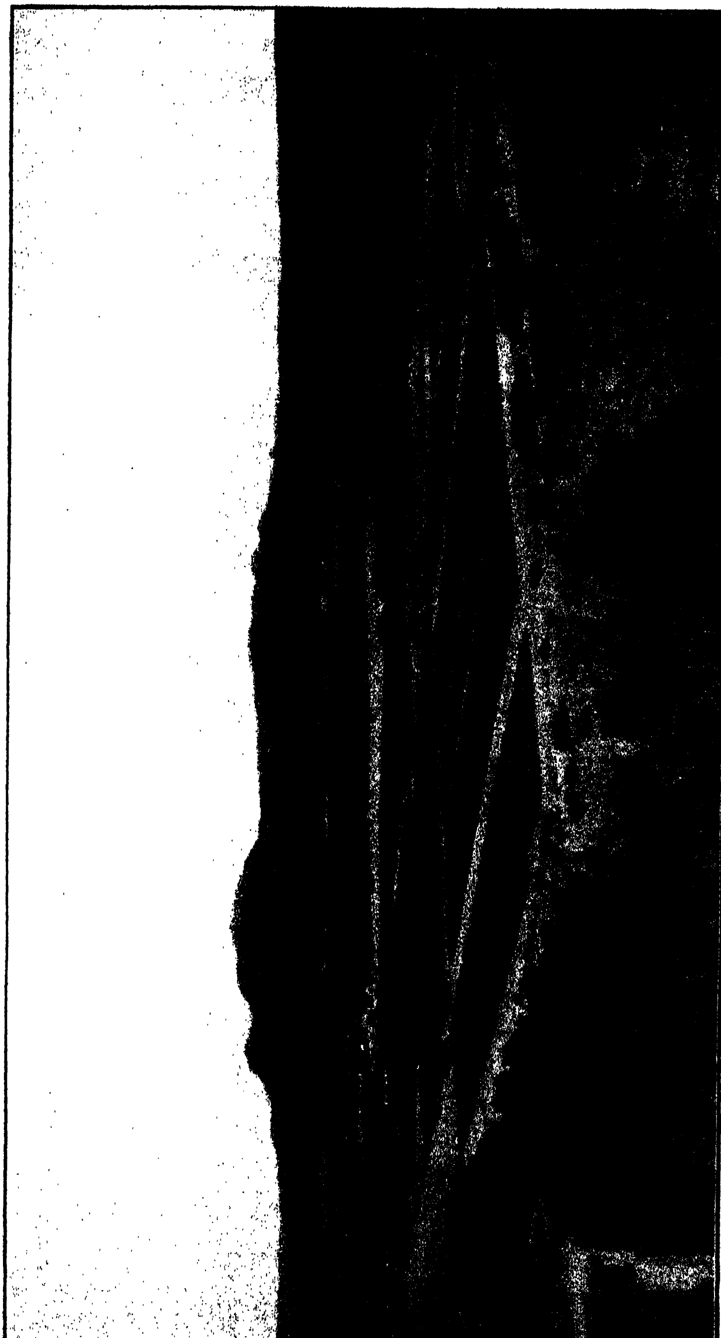
Potatoes grown under irrigation are usually ridged, making flooding impracticable. As this crop requires friable, well-drained soil, it is evident that it lends itself admirably to the furrow system, where a small stream can be run down every row or every other row, with the result that only a small portion of the surface soil actually comes into contact with the irrigation water. This makes for a reduction in loss by evaporation and helps to keep the soil loose and open round the plants where tuber formation is taking place.

When the soil is flooded it tends to pack round the plant and on drying out, especially in somewhat heavy soils, cracks, thereby exposing the potatoes to sun scald and injury by tuber moth. The soil is likely to be less well-drained, making conditions favourable for eel-worms which are partial to damp, poorly aerated land.

The furrow system will, of course, make for economy in the use of water, and will permit of the use of a relatively weak stream which could not be used for flooding.

A further advantage of the furrow method lies in the fact that if it should be desired to allow the crop to lie on the ground over winter (late-planted crop) earthing up of the potato will be facilitated and the rows being well defined will make for easy harvest. Then again if potato ploughs are used for lifting the crop they will do the work better on soil that has not been packed round the tubers, which would result where flooding is practised.

* Utah Bulletin, No. 117, p. 89, 1912.



General View of the Irrigation Experimental Block at Grootfontein School of Agriculture, Middelburg, Cape.

Quantity of Water per Irrigation.—The potato requires a soil that is uniformly moist, particularly from the time that tuber-formation commences until just before maturity. If the crop should suffer during that time from lack of water, poorly shaped tubers will result (large number of second growths). For this reason regular, light irrigations are to be preferred to heavy waterings at longer intervals. The furrow method is admirably suited to the former. Heavy applications at longer intervals may give quite satisfactory results provided the soil has a good moisture-holding capacity (plenty of decomposed organic matter), and provided that the irrigations coincide with the stages that require water most. Very heavy irrigations will result in the packing of the soil, which is most undesirable for this crop.

TABLE XIII.

*Effect of Regular Applications on Yield of Potatoes.**

Inches per Week.	Total.	Yield in Bushels.	Size of Tubers.
1 in. weekly	12·8 in.	337	3·5 oz.
2½ in. "	32 "	300	3·0 "
5 in. "	64 "	190	2·5 "
7½ in. "	96 "	140	2·3 "

Stage at which to Irrigate.—Critical stages in the growth of the potato are tuber-formation, full bloom, and shortly before the crop matures. The last stage may not appear on the surface to be of any great importance, yet, when it is stated that the tubers double in weight during the last month before maturing, it will be clear why a good supply of moisture at that time will be required. Tables XIII and XIV make clear these very interesting facts.

TABLE XIV.

*Effect of Stage of Growth at Irrigation on Yield of Potatoes.**

Stage of Growth.	Amount of Water.	Yield in Bushels.	Size of Tuber.
5 in. before plants up	5 in.	139·0	2·6 oz.
5 " (1) 4 inches high	5 "	193·9	3·1 "
5 " (2) tubers forming... ...	5 "	201·4	3·3 "
5 " (3) full bloom	5 "	229·0	3·4 "
5 " (4) just before ripe ...	5 "	180·1	3·3 "
5 " each at stages (1) and (2)...	10 "	165·0	3·0 "
5 " " " (2) " (3)...	10 "	230·7	3·8 "
5 " " " (3) " (4)...	10 "	255·4	3·8 "
5 " " " (1) " (4)...	10 "	226·3	3·1 "
5 " " " (1) " (3)...	10 "	204·6	3·3 "
5 " " " (2), (3), (4)...	15 "	294·8	3·7 "
5 " " " (1), (3), (4)...	15 "	257·2	3·4 "
5 " " " (1), (2), (4)...	15 "	256·4	3·3 "
5 " " " (1), (2), (3)...	15 "	246·4	3·6 "
5 " " " (1), (2), (3), (4)	20 "	317·3	3·8 "

* Utah Bulletin, No. 157, p. 19, 1917.

Summary of Treatments giving Highest Yields.

Stage of Growth.	Amount of Water.	Yield in Bushels.	Size of Tuber.
1 inch weekly	12·8 in.	337·0	3·5 oz.
Stages (1), (2), (3), (4)	20 "	317·0	3·8 "
" (2), (3), (4)	15 "	294·8	3·7 "
" (3) and (4)	10 "	255·4	3·8 "
" (3)	5 "	229·0	3·4 "

In the first place it will be noted that light weekly irrigations are most favourable to the crop for reasons already explained. Frequent heavy waterings may seriously reduce the yield. When one irrigation only is given the most important stage is that when tuber-formation is starting, while the poorest returns result from one irrigation before the crop is up. With two waterings, the important times are either at full bloom and shortly before maturity or at tuber-formation and full bloom. Most satisfactory results follow three irrigations, at the tuber-formation, full-bloom, and before-ripe stages. It will also be observed that those irrigations that give the largest yields also result in the production of the largest tubers.

Quantity of Water per Season.—It is doubtful whether at any time it would be economical to use larger quantities than twenty inches per season, and even less will frequently give excellent returns if distributed correctly—*vide* Table XV and those already referred to.

TABLE XV.

*Effect of Spreading a Given Quantity of Water on One or More Acres on Yield of Potatoes.**

	Thirty Acre Inches on.				
	One Acre, 30 Inches Deep.	Two Acres, 15 Inches Deep.	Three Acres, 10 Inches Deep.	Four Acres, 7·5 Inches Deep.	Six Acres, 5 Inches Deep.
'ield marketable tubers in bushels...	195	373	456	544	691

SUMMARY.

(*a*) In irrigation practice it should be remembered, with annual crops particularly, that the first irrigation after sowing should be delayed as long as possible (without doing damage to the crop by allowing it to become severely wilted).

(*b*) This is possible by establishing crops on soil well charged with moisture. It should always be the aim to give a thorough irrigation before sowing, if the soil has not been well moistened by rain. If (*a*) and (*b*) are carried out, it will be found that a deep root system will develop, the crop will be more thrifty and fewer irrigations will be required later.

(*c*) Subsequent irrigations should be given at those stages in the growth of the crops which require moisture.

* Utah Bulletin, No. 117, p. 111, 1912.

(*d*) In general, with soils three feet or more in depth, applications of about four to five inches at a time will be most satisfactory (small regular irrigations are better for potatoes), as heavier waterings will result in loss by seepage, while lighter irrigations are impracticable, as a rule, and mean more work and greater loss by evaporation.

(*e*) Most annual crops will give excellent yields with only three irrigations after planting.

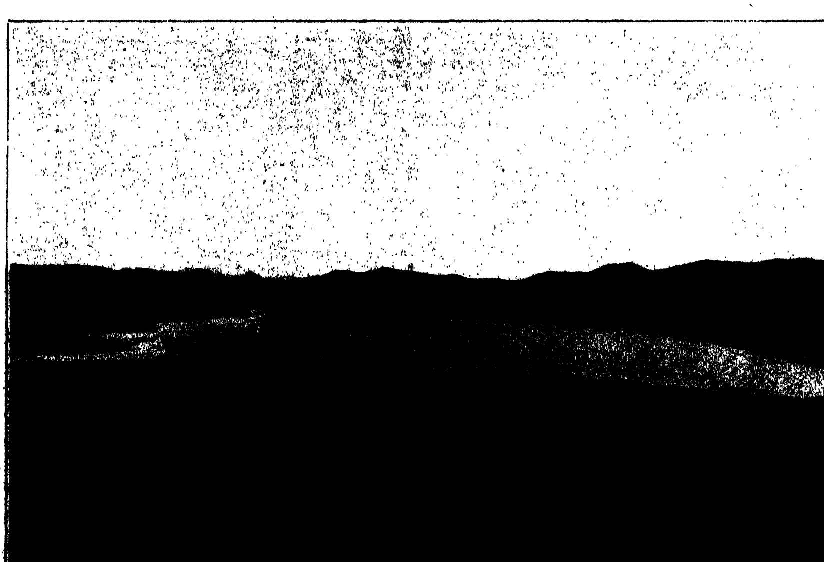
(*f*) Remember that a fertile soil makes for the economic use of water.

(*g*) Weather conditions have a very marked effect on the water requirements of crops. Excessively windy and dry seasons will increase the water cost of crops.

CONCLUSION.

In conclusion, it may be stated that the limitations of this paper are appreciated by the writer, for the recommendations made are largely the result of experience in foreign countries, supplemented to some extent by observations made locally. It is felt that there are some broad principles that will apply under the most variable climatic conditions, and if the reader only takes away with him the fact that heavy irrigations are not economical and are even injurious to the soil and the fact that there are critical stages in the growth of most of our crops, it is felt that a certain amount of good will have been achieved.

We do not wish, in this country, to repeat the costly experience of pioneer irrigators of other countries and ruin our land through over-irrigation, and it is felt that once we appreciate the principles underlying scientific irrigation there should be no fear that we shall run the risk of spoiling our fertile irrigation lands.



Water Conservation of the Karroo.

SHEEP BLOW-FLY CONTROL: A NEW METHOD.

By BERNARD SMIT, M.Sc., Entomologist, School of Agriculture, Grootfontein.

IT has become increasingly evident during the course of the Sheep Maggot Investigations, now being conducted at Grootfontein School of Agriculture, that one of the most important control measures for the Sheep Blow-fly pest is the proper disposal of carcasses.

The three species of flies that have so far been found to attack live sheep in South Africa—namely, *Lucilia sericata*, the English sheep-fly; *Chrysomyia albiceps*, the green-banded blow-fly; and *Chrysomyia chloropyga*, the green and blue blow-fly—breed very readily in carrion. In fact, it would appear that meat is the natural food of the maggots of these flies, and that their habit of blowing the wool of live sheep has been acquired since man has bred long-woolled varieties.

SHEEP CARCASSES AND FLY INCREASE.

In order to obtain an accurate idea of the number of sheep blow-flies that breed in carcasses left in the veld, two dead sheep were left exposed to the flies. When they had been fully blown and the maggots nearly fully developed in them, they were covered with gauze cages. As soon as the flies began to emerge, the sides of the cages were darkend with tar-paper and the flies caught at the top of them in specially constructed traps. These traps were emptied each day and the flies identified and counted.

The first carcass was exposed on the 4th of January. It was a small sheep weighing thirty-six pounds. On the 8th of February, the flies began to emerge. Notwithstanding the presence of thousands of hymenopterous parasites, 1,451 banded blow-flies (*C. albiceps*) emerged.

The second carcass was set out on 22nd May, and as the weather was colder the flies did not begin to emerge till the 20th of August. No banded blow-flies emerged from this carcass, but 596 green and blue blow-flies (*C. chloropyga*) and 9,696 English sheep-flies (*L. sericata*) emerged, the last flies emerging on the 23rd of October.

It will readily be seen, therefore, that a few such carcasses left on a farm would produce enough sheep blow-flies to cause a heavy infestation of live sheep by maggots.

DISPOSAL OF CARCASSES.

Burning.—Various methods of disposing of carcasses have been suggested and tried. In parts of America and Australia it is a common practice to burn carcasses either out on the range where the animals die or in a specially built incinerator. This necessitates the use of fuel. In the former country crude oil is often used, and

in the latter, wood or dried dung. In South Africa, especially in the Karroo, fuel is scarce, and both oil and wood very expensive. The burning of carcasses is, therefore, not often feasible.

Burying.—The burying of carcasses is often recommended, but this, too, is no easy task in most parts of our country. During a drought, when sheep may die in large numbers, the ground is usually very hard, and the digging of holes sufficiently deep to bury sheep properly is next to an impossibility. It has been shown from experiments in which sheep blow-fly puparia were buried to different depths, that the flies are able to emerge from under at least two feet of soft earth. It is therefore evident that a carcass infested with maggots should be buried at least three feet below the surface of the soil and the soil should be well stamped down over it to prevent the flies from getting out. Much depends, naturally, upon the type of soil in which the carcass is buried. There are records of the English sheep-fly having emerged from under six feet of very soft, light soil.

Poisoning.—Much has been said in favour of poisoning carcasses with arsenite of soda, the object being to prevent flies from breeding in carcasses and also to poison the flies that visit such. Many farmers claim that enormous numbers of flies can be killed in this way.

But poisoned carcasses are dangerous things to have lying around the farm; and, if this method is used, it is necessary to enclose them so that dogs and other animals may not be poisoned. The most satisfactory method of doing this is to dig a pit about two feet six inches deep into which the carcasses are thrown. Jackal netting is then stretched over the hole and pegged down tightly.

This method was tried at Grootfontein in order to test its efficiency. Both pure and sweetened solutions of arsenite of soda were used. The sugar added to the solution did not seem to render it any more attractive to the flies than the pure solution. Various strengths were tried and it was found that half an ounce of arsenite of soda dissolved in one gallon of water gave the best results. This is most conveniently made up by disolving two ounces of the arsenite of soda in a petrol or paraffin tin full of water.

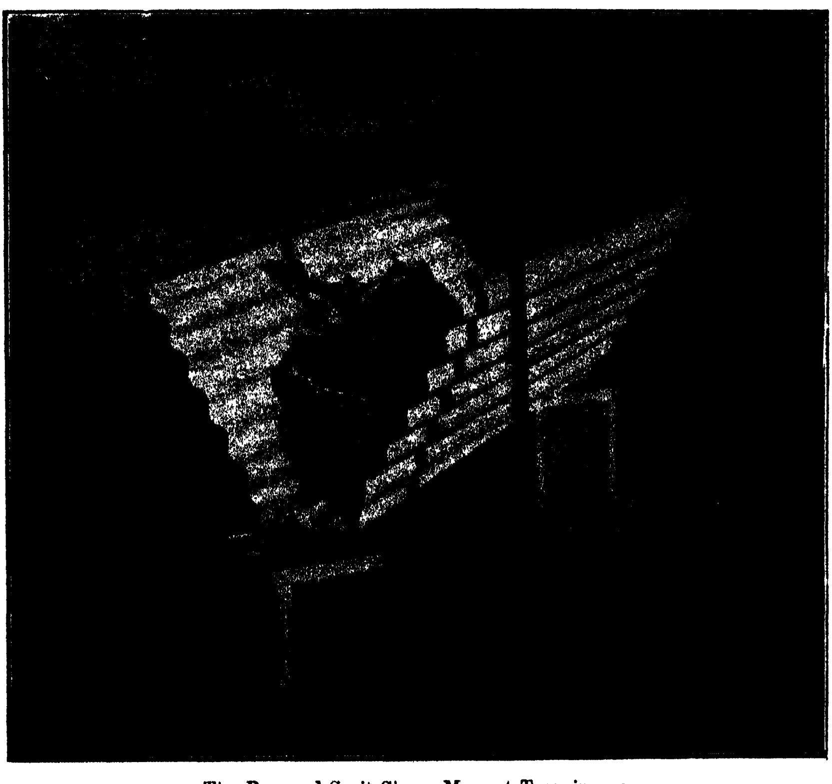
Each carcass was left for two days before spraying it with poison so that it might become fully blown and attract as many flies as possible. By the end of the two days there were masses of maggots in the carcasses, and the vicinity of the holes was swarming with blow-flies. The poison was then put on and seemed to repel the flies so that comparatively few were killed. By the following day most of the maggots were dead. There were a few dead flies scattered in and around the holes.

The poison was sprayed on lightly each morning, and as the carcasses had been cut open and the entrails spread out, a good penetration was obtained. By the sixth day practically all the maggots in the carcasses were killed, except a few that managed to develop in some sheltered crevice where the poison had not reached them. These migrated from the carcasses and pupated, the flies finally emerging.

Flies swarmed around the carcasses until the fifth day after they were put out. By the sixth day nearly all the smell from the carcasses had gone off and the flies had disappeared. The arsenite

had acted as a preservative and stopped decomposition. The meat had turned whitish and become hard as if it had been salted, notwithstanding that the weather had been damp with frequent thunder showers and heavy dews at night.

It was impossible to tell how many flies had been poisoned with any degree of accuracy, but, on the whole, the results in this direction were disappointing. The bottoms of the holes were sprinkled with dead flies, but by no means covered with them. There was also a sprinkling of flies on the ground immediately around the holes. It did not appear, from the habits of the flies, that many had flown right away from the carcass after taking the poison.



The Bernard Smit Sheep Maggot Trap in use.

Those flies that were seen to take the poison became sluggish and did not fly far before dying.

Spraying was continued until the ninth day, but no blow-flies came to the carcasses after the sixth day and no further maggots developed in them. The carcasses finally turned quite white and settled down in tough masses which gave off practically no smell. They were buried in the holes on the eleventh day after setting out.

These experiments showed that the spraying of carcasses with a solution of arsenite of soda prevents flies from developing in them and poisons a fair number of flies. The method entails a considerable amount of work and is objectionable on account of the use of poison, which is always accompanied with danger.

THE NEW TRAP METHOD.

For this reason a new method of disposal of carcasses has been tried and promises very well. It consists in the use of a maggot trap that acts on the same principle as the Baber House-fly Maggot Trap, which has been used so successfully in the control of house-flies. The maggot trap is built in the form of a trough. It is made of two six-foot pieces of corrugated-iron, bolted together side by side with ordinary veranda bolts, and the whole then bent into a trough with its ends open as shown in the accompanying illustration. The top edges of the trough are bent inwards to prevent maggots from crawling over the sides. It is hung with pieces of wire between four fencing poles so that its open ends are directly over paraffin tins. These tins have their tops cut open in such a way that there is a rim of tin about half an inch wide left all round inside their tops. This is very easily done with an old knife and a hammer. The tins are kept in place by banking a little soil around them.

All carcasses are simply thrown into the trough and are not poisoned. Flies are attracted to the carcasses in tremendous numbers and lay masses of eggs in them. The carcasses soon swarm with maggots and are consumed until nothing is left of them but the skeleton and a little dried-up skin in which no further flies will develop. They can then easily be burned without the use of fuel, being thoroughly dry.

The maggots, when full-grown, crawl away from the carcasses and fall into the paraffin tins at the open end of the trough. When once in the tins they are killed by pouring a little water and paraffin over them.

From four carcasses handled in this way, two paraffin tins almost full of dead maggots were obtained. The maggots were thrown out on the veld where they dried up, but it is hoped that a method of preserving them for poultry food may be found.

The advantages of the trap are as follows:—

(1) The carcasses are simply and easily disposed of. There is no immediate need to poison, burn, or bury them.

(2) The carcasses are reduced to a state in which they are readily combustible, if it is desired to burn the remnants.

(3) The flies are drawn away from the live sheep and enticed to lay their eggs where these will ultimately be destroyed as maggots.

(4) The maggots may perhaps be made use of as poultry food.

(5) With certain facilities, it may be possible to augment the supply of the beneficial parasite, *Nansonia brevocornis*. Thus, the maggots may be allowed to pupate in cages from which no developing flies can get out, but from which the tiny parasites can escape.

PRINCIPAL AGRICULTURAL ACTS OF THE UNION.

VII.

Legislation of the 1925 Session.*

The Wild Birds Export Prohibition Act, No. 6 of 1925.

The exportation by land or sea from the Union of wild birds of any species is prohibited, except under permit issued at the entire discretion of the Minister of Agriculture, who will also insert in any permit such conditions as to him may seem meet. And every permit will be available for the use only of the person to whom it is issued.

By notice in the *Gazette* the Minister may, however, grant authority, subject to conditions he may deem necessary, for the exportation by persons generally from any specified district of specified species of wild birds, and he may at any time cancel or amend such notice.

Contravention of this Act is punishable by fine or imprisonment or both, and any Court may order the release of all wild birds held in captivity for purposes of exportation by or on behalf of any person convicted.

The Orchard Cleansing Act, No. 13 of 1925.

This Act provides for the cleansing of orchards in respect of insect pests and plant diseases. It will be compulsory in all areas of the Union where residents through their divisional councils or by combined application, in a manner prescribed by the Act, desire it.

After the various requirements referred to above have been complied with (resolution of a divisional council—passed at an ordinary meeting, etc., as required by the Act—recommending it; or requested by twelve or more owners of holdings in areas where no divisional council has jurisdiction), the Governor-General will proclaim that the cleansing of orchards (that is any fruit tree or collection of fruit trees growing upon a holding, whether capable of bearing fruit or not) in respect of specified insect pest or plant disease is obligatory in such areas.

Thereafter in the proclaimed area an officer may at any time enter upon land to inspect an orchard and ascertain whether any specified insect pest or plant disease is present. If such be discovered then the owner or occupier of the orchard will be instructed in writing (or by other prescribed means if he be absent) to cleanse the orchard in a manner set out in such notice. If this instruction is not obeyed or the orchard not properly cleansed, it will be an offence liable to a fine not exceeding £50, and the Government may order the orchard

* Other Acts affecting Agriculture passed during the 1925 session were the Fruit Export Control Act, No. 12 of 1925, an outline of which was published in the October, 1925, issue of the *Journal*, and the Co-operative Societies Act, 1922, Amendment Act, No. 38 of 1925, which will be dealt with in a later issue of the *Journal*.—EDITOR.

to be cleansed at the expense of the occupier or owner, plus 10 per cent. of such expense.

Within any proclaimed area in which the owners of holdings deem it necessary, the Government may appoint an officer with duties such as described above and defray his salary and travelling expenses out of a levy, if the amount and incidence of the levy was stated in the original resolution asking for compulsory cleansing, and is sufficient to cover such expenses, provided that the levy shall be made only in respect of such orchard as is liable in the opinion of the Government to be infected with the proclaimed insect pest or plant disease.

The Act provides for the recovery of costs of any cleansing carried out, and for the noting (in the form of a mortgage at 6 per cent. interest) of such costs against the title of any holding if the whereabouts of the owner or occupier is not known, or in any other case in which the Government agrees to a postponement of the payment of the costs.

Any holding in a non-proclaimed area adjoining one in a proclaimed area will similarly be subject to the provisions of the Act.

Regulations are provided for prescribing the duties of officers (i.e. an officer of the Department of Agriculture or any other person appointed for the purpose); the methods of cleansing orchards; the payment of costs, etc.

The Agricultural Industries Advancement Act, No. 16 of 1925.

Throughout the Act "agricultural product" means ostrich feathers, pigs, bacon, sugar-cane, sugar, and cheese. Whenever application is made to the Government—

(*a*) by factories which manufacture more than 50 per cent. of an agricultural product handled in all factories in the Union; or

(*b*) by co-operative societies controlling more than 50 per cent. of any agricultural product;

that a levy be made in respect of such product, the Government may make such levy, which, however, will be withdrawn when the quantity concerned in (*a*) and (*b*) above falls to 50 per cent.

In regard to ostrich feathers, the Act covers the levy of 2 per cent. *ad valorem* (in terms of Government Notice No. 1469 of 29th August, 1923). The levy is made on the value of feathers declared at the port at time of shipment and is payable by the shipper. It will continue until the amount so levied reaches the sum of £14,000.

The proceeds of any levy will be devoted to the encouragement of the growth and production of the particular product by (*a*) experiment, investigation, research, or instruction, including the acquisition of land, buildings, live stock, etc., in connexion therewith; (*b*) the advertisement and more advantageous sale of the product; or (*c*) any other means that the Government considers will promote the interests concerned in the product; provided the above means are concurred in by those who applied for the levy.

The proceeds of a levy will be paid into a special account, out of which the Government will direct payments to be made to (*a*) any co-operative society or company which has among its objects the most

advantageous production and sale of the product concerned, or (b) any other combination of producers which, to the satisfaction of the Government, will wholly apply such moneys to the promotion of the further production and sale of that product. The Government itself may, however, expend such moneys.

All such money must be devoted wholly to the purpose for which it is made available, and where this is not being done the Government will discontinue payments, and may recover by action in a competent Court the money that has not been properly expended.

With the concurrence of those applying for the levy, regulations according to the product (and with penalties) may be made prescribing

(a) the amount of any levy, the manner in and the purposes for which it shall be made, and the time at and period for which it shall be paid;

(b) the manner in which payments shall be made, expended, and accounted for;

(c) reports or other information to be furnished;

(d) forms of notices, etc., to be used; and generally for the better carrying out of the objects of the Act.

Amendments to other Acts.

In regard to the Agricultural Products Grading Act, 1922, any standard of composition and quality, and any label, mark, brand, etc., representing such, prescribed by the Government, may not be applied to any similar agricultural product which has not been inspected and graded under that Act.

Further, whenever any particular product is inspected and graded at the instance of any factories or co-operative societies controlling more than 50 per cent. of the entire quantity of that product manufactured by all factories, etc., the Government may designate officers in the Department of Agriculture to inspect and grade also the said particular products of all other factories, etc.

The words "or wool or mohair or ostrich feathers" are deleted from the definition of "agricultural produce" under Section 12 of the Agricultural Produce Export Act of 1917, as amended by the Agricultural Products Grading Act of 1922. This means that regulations for standardizing and marking receptacles can be framed if necessary, and no regulation may be promulgated under these Acts fixing grades for wool, mohair, or ostrich feathers.

Diseases of Stock Act, 1911, Further Amendment Act, No. 18 of 1925.

This Act amends Section 16 of Act No. 14 of 1911 by extending the powers of the Minister in the issue of orders for compulsory dipping, enabling him to prescribe methods of dipping, periods for dipping, as well as definite dates within such periods as may be fixed by officers described in the Minister's order.

The Act brings also within the above amended section any Ministerial order issued prior to the commencement of the amending Act, under Section 16 of Act No. 14 of 1911, so validating any action taken or purporting to have been taken by any officer of the Department of Agriculture in this respect. But this section will not affect any judgment given in any Court prior to the 12th May, 1925.

The Public Auctions and Transactions in Live Stock and Produce Act, No. 22 of 1925.

Live Stock.—Every sale of live stock by auction must be held in a place to which all members of the public have free access. This does not apply to a sale held in any enclosure, building, tent, etc., in connexion with any church or charitable organization, agricultural show, or race-meeting, provided all people in the enclosure or building, etc., have free access to such sale.

Every auctioneer conducting a sale of live stock by auction must—

(*a*) plainly and audibly announce the name of the purchaser of any live stock; and

(*b*) immediately after the sale furnish each seller with a sales-note showing (i) name of the seller, (ii) name of purchaser, (iii) number and description of animals sold, (iv) prices at which sold, (v) full list of deductions by auctioneer in respect of commission and other charges, such as railage, feeding, weighing, driving fees, post, telegrams, insurance, etc. (excepting that these deductions need not be given until the completion of the sale when it is effected partly by auction and partly by private treaty), and (vi) the net amount due to the seller.

In connexion with such sale no auctioneer may give or offer any secret or undisclosed rebate; refuse to accept any bid unless he can prove that the bidder cannot meet payment; sell to himself or any one with whom, directly or indirectly, he is associated in business; and pay or credit to the seller a sum less than the net amount due to the seller as referred to above.

Agricultural Produce.—The above procedure applies also to auction sales of agricultural produce (that is, meat or any product thereof, butter, cheese, eggs, and any article whatever produced or derived by farming operations, including fruit, wool, mohair, and ostrich feathers.) But sales amounting to £5 of agricultural produce not intended for resale may be exempted by the Government by notice in the *Gazette*.

Whenever wool, mohair, hides, skins, cotton, sugar or the products of sugar-cane, or ostrich feathers are sold through an agent, he must, immediately after the sale, furnish the seller with a sales-note showing (i) the name of the seller, (ii) the name of the purchaser if the seller is a farmer or sugar-miller, (iii) the weight or quantity of the articles sold, (iv) the prices obtained, (v) full list of deductions for commission, railage, cartage, storage, weighing, sorting, classifying, post, telegrams, insurance, etc., and (vi) the net amount due to the seller.

Further, the same provisions apply in respect of secret rebates, refused bids, etc., as referred to in the relative paragraph above.

General.—Contraventions are punishable by fine or imprisonment or both, and on conviction any licensed auctioneer or agent is liable to have his licence cancelled.

By notice in the *Gazette* the Government may prescribe the characteristics of any particular live stock or agricultural produce.

INQUIRIES AND REPLIES.

SELECTED LETTERS FROM FARMERS.

[Hereunder are a number of recent letters replied to by the various Divisions and Schools of Agriculture concerned. They are selected for publication as being of interest to farmers generally in the localities affected. In each case the area only from which the inquiry emanates is given; as the replies must necessarily be curtailed, they will indicate, when required, literature from which further information may be had. All departmental bulletins quoted are obtainable on application to the Editor.]

Early Spraying and its Effect on Bees.

Bloemfontein.—Many of my bees are dying, in fact my hives are getting thinned out. Will spraying fruit trees for codling-moth affect the bees?

Glen School of Agriculture replies: You are spraying fruit trees too early. This early spray covers the pollen with arsenate of lead, and prevents pollination. It also covers the flowers with a coating of arsenate of lead when the bees are about to do their work, inflicting heavy toll on the bees. Spray, therefore, when the fruit is set; you will get good fruit and no damage will be done to your bees.

Maize for High Altitudes.

Harrismith.—What varieties of maize (white and yellow) are the most suitable for growing in this area? The altitude is about 6,000 feet, and maize grows so slowly that often it does not ripen.

Glen School of Agriculture replies: The best yellow varieties for your climate are Cincinnati (Large Boesman) and Natal 8-Row, and the best whites American White Flint and White Cango. These varieties are all fairly early maturing. By seed selection it is possible to make them mature earlier. Select seed from healthy plants, which ripen early, and establish a small seed plot, by means of which the seed may be gradually improved year by year.

Chickens Dying in the Shells.

Dewetsdorp.—What is the reason for chickens dying in their shells?

Glen School of Agriculture replies: The first thing to be examined is the breeding pen. It may be that the fowls are too fat or too much inter-bred or of a weak constitution. It is not advisable to breed from pullets under twelve months old. See that the pens are not supplied with forcing food, but let them have an ample amount of green food and much exercise. If certain that the pens are in good condition and the treatment proper, the incubator should next be examined if further cases of chickens dying in shells arise.

Soil Requirements.

Heilbron, Orange Free State.—I am sending you a small sample of my maize soil: kindly advise me what fertilizer to use.

Glen School of Agriculture replies: Your soil appears to be a typical sandy soil of the northern Free State. The first apparent deficiency of this soil is humus, which is a valuable constituent supplying nitrogen and influencing tremendously the structure and tilling properties of the soil. More humus in the soil will give it a more granular structure, improve the water-holding capacity, and prevent any tendency to blowing. Humus is rotted plant material, and the best way of supplying this to the soil is either by the use of kraal manure in liberal amounts or by green-manuring. For the former the manure should be spread over the land and be ploughed in, preferably some time before the seed is planted. Five to eight tons per acre is a good amount. Green-manuring consists of sowing each year a different area of land to cow-peas and ploughing these under just as the pods begin to form. Once in every four or five years is ample.

The other deficiency to expect in your soil is one which is common to almost all South African soils, namely, "phosphates." Phosphates have a very strong influence on the yield of the crops, over 100 per cent. increases having been reported to us. The best form in which to apply this constitutent is "superphosphate" which is obtainable at about £5 per ton. It is best applied to the soil through the fertilizer attachment of the planter at the rate of 150-200 lb. per acre (or roughly one ton of superphosphate per bag of seed maize). It is a good plan to mix some fine kraal manure with superphosphate in order to overcome the tendency it has to pack and clog in the attachment. A convenient ratio is one superphosphate to three kraal manure. If this mixture is used apply 600-800 pounds per acre.

Testing Cheese.

Ladybrand, Orange Free State.—I require a supply of one-tenth normal caustic soda solution and indicator for testing in cheese manufacture. Can your Institution supply me with these solutions at regular intervals?

Glen School of Agriculture replies: We are not able to supply one-tenth normal caustic soda solution or indicator, but only one-tenth normal sulphuric acid. The one-tenth normal sulphuric acid is used to standardize the caustic soda solution, but a certain amount of instruction in its use is needed, and unless you have had experience of standard solutions and their preparations and use, a one-tenth normal sulphuric acid would not be of much use to you. The indicator is a 1 per cent. solution, in alcohol or good methylated spirits, of phenolphthalein. Phenolphthalein is a white powder, obtainable from the chemist. A one-tenth normal solution of caustic soda contains 4 grammes of pure caustic soda per 1,000 cubic centimetres of pure water. If you yourself are not in a position to make it up by using one-tenth normal sulphuric acid, purchase it ready made from some reliable chemist.

Economical Power for the Farm.

Jammerdrift, Orange Free State.—I intend to invest in an engine, mill, and mealie sheller. Which do you consider most economical—oil, paraffin, or petrol engines? A suction gas engine is very economical, but what about the initial outlay? And can a portable one of 12 horse-power be procured?

Glen School of Agriculture replies: A 12-horse-power engine will be suitable for your purpose. As to the three types of engines stated, give the paraffin engine preference: paraffin is more easily procured than crude oil and weight for weight more powerful, while there is more uniformity amongst the various brands than there is in crude oil. Petrol is too expensive for engines of the stationary type of the size you require, and it is usually advisable, when the horse-power exceeds six, to instal paraffin engines as prime movers. But give the suction gas engine your consideration should you decide on a stationary plant.

The initial outlay on a suction gas plant is certainly greater, and since the gas-producer must be taken into consideration the depreciation is more, but the saving in running usually justifies the extra initial cost and higher depreciation.

The paraffin engine makes the most convenient form of portable engine. The gas engine does not adapt itself to this form of plant since the gas-producing plant is more cumbersome, and a steady supply of water is necessary for the scrubber, etc.

The comparative costs of fuel are given, approximately, below: they vary according to locality, etc. A well-constructed oil engine will consume ¾ pint of paraffin per brake horse-power per hour, and assuming the average load to be 10 horse-power, the fuel consumed will be 7½ pints per hour. With paraffin at 10s. per four-gallon tin, the cost of fuel would be approximately 2s. 4d. per hour. A gas engine will consume 1 pound of anthracite per horse-power per hour, and under a similar load will use 10 lb. at 25s. per ton of 2,000 lb. = 1½d. per hour. Overnight and firing-up losses may be added at the rate of 20 lb. per day for a plant of this size, giving a total of 100 lb. per 24 hours, 8 hours of which are running hours.

Assuming, as a convenient basis to obtain comparative figures, that the oil engine cost £100 and the suction gas plant £200, the greater economy of the latter will be seen, viz.:—

		Oil Engine.		Suction Gas Plant.
Initial cost		£100		£200
Depreciation	7 %	7	12 %	24
Interest	6 %	6	6 %	12
Total written off annually ...		13		36
Cost of fuel for, say, 300 days of 8 hours...		280		19
TOTAL		£293		£53

These figures show an annual saving of £240 in favour of the suction gas engine. Lubricating oil and supervision are taken as equal in each case.

Fattening Lambs for the Butcher.

Grahamstown.—I intend putting Persian lambs, just weaned, into a small camp or kraal, and feeding them entirely on lucerne hay and prickly pear, with the addition of a little cow meal if recommended. My object is to fatten these lambs as rapidly as possible, and when weighing about 25 lb. dead weight to sell them to the butcher. Would the above foods be likely to give the desired result, and be a payable proposition? For the past two years I have been feeding my ewes and lambs (Persians) on unchaffed lucerne hay, which the sheep eat from wire-netting racks. the sheep are herded into the veld by day and kraaled by night, getting as much hay as they will clean up during the night. I am not satisfied with the results. Would the addition of prickly pear be beneficial? These sheep are fed only when the veld is dry and not continuously.

Grootfontein School of Agriculture replies: In order to make an economic success of fattening lambs the period of fattening should be a short one, so as to give a quick turnover. Your Persian lambs should dress 25 lb. comfortably after 90 days feeding. Run them in a small camp, with shelter if possible, and feed them 2 lb. prickly pear, 1½ lb. lucerne hay, and ⅓ lb. cow meal. Let them feed the lucerne hay from racks and feed the prickly pear and cow meal mixed. The lambs may not take to the latter very readily, but by adding a little salt they get accustomed eventually. Cut the prickly pear in one-inch slices with a forage cutter or use a mangel cutter. It is doubtful whether lucerne will give better results when passed through a chaff cutter. It only means extra expense and probably waste.

Mangel wurzel is a better food than prickly pear, pound for pound, but it is expensive to grow, and from an economic point of view the prickly pear is probably superior.

If you make a detailed analysis, and calculate how much it costs you to feed one lamb for 90 days at the above rates, and knowing your local market value for these lambs, you may draw your own conclusions as to whether the margin of profit is high enough.

We would advise you to go in for Suffolk-Black Head Persian crosses. At Grootfontein we have compared the pure-bred Black Head with the Suffolk cross. The following table gives the comparison. These sheep have run together on the veld since lambing. None has been slaughtered yet to ascertain the dress weights:—

	Suffolk-Persian Cross.	Pure-Bred Persians.
Age 3 months	39.64 lb.	30.02 lb.
Age 6 months	58.02 lb.	43.90 lb.
Age 12 months	82.70 lb.	58.70 lb.

Making Jeripico and Port Wine.

Wellington.—What is necessary for making Jeripico wine?

The Government Viticulturist, Elsenburg, replies: Three things should be known in making Jeripico or sweet wine:—

(1) The alcoholic strength of the spirit to be used;
(2) the alcoholic strength of the wine or must; and
(3) the alcoholic strength of the mixture or the wine you purpose to make.

If the spirit at your disposal has an alcoholic strength of 20 O.P. it means that by adding 20 gallons of water to 100 gallons of spirit of 20 O.P., 120 gallons spirit of proof strength are obtained. To determine how much spirit should be used it is essential that the calculation should be made in proof strength. Now a mixture of must and spirit is made to obtain Jeripico of 30 P.S. Two things are now known: The spirit is of 120 P.S. and the proof strength required for Jeripico is 30. What then should the alcoholic strength of the must be? For Jeripico unfermented must, which contains no alcohol, must be used. Calculations must now be made in the following manner:—

Strength of Spirit (S) = 120.
Strength of Jeripico (J) = 30.
Strength of Must (M) = 0.

$$\frac{J - M}{S - J} = \frac{30 - 0}{120 - 30} = \frac{30}{90}.$$

To 90 gallons 30 gallons are added.

To 100 gallons $\frac{30 \times 100}{90}$ gallons are added = 33·33 gallons, viz.: 33·33 gallons spirit of 20 O.P. to 100 gallons of must.

If the spirit is of 50 O.P. then the required quantity is calculated in the following manner:—

$$\frac{J - M}{S - J} = \frac{30 - 0}{150 - 30} = \frac{30}{120}.$$

To 120 gallons 30 gallons are added.

To 100 gallons $\frac{30 \times 100}{120}$ gallons are added = 25 gallons spirit.

For making port wine, which should have an alcoholic strength of 30 degrees P.S. and which requires 10 to 12 per cent. of sugar, operations should be conducted on the following lines: Strength of the spirit is 50 O.P., the sugar-content of the must is 22 degrees Balling: and every degree of sugar in fermenting will produce one degree of proof strength. Of the 22 degrees now present, only 12 degrees must be retained; consequently fermentation of 10 degrees must take place. With must of 10 degrees P.S. the following figure is obtained:—

Must (M) 10 degrees P.S.
Port wine (P) 30 degrees P.S.
Spirit (S) 150 degrees P.S.

$$\frac{P - M}{S - P} = \frac{30 - 10}{150 - 30} = \frac{20}{120}.$$

To 120 gallons 20 gallons are added.

To 100 gallons $\frac{20 \times 100}{120}$ gallons are added = 16·66 gallons.

With port and sweet wine the treatment is as follows: First allow the must to ferment. If it ferments well the spirit is added and thoroughly mixed with the must. After two days it is thoroughly aerated by pumping over. It should have sufficient air. After two or three days the process is repeated and so on for three or four times. After that allow it to stand over for some time.

Theoretically it is calculated that there will be no further fermentation after the alcohol has reached 30 degrees P.S., but in

practice this is not always the case. At times fermentation stops too soon and sometimes more sugar is fermented out than calculated, but usually it follows a normal course. When such wine has totally stopped fermenting it should be instantly tested as to its strength and condition. In case it has not sufficiently fermented more spirit should be immediately added. It must be borne in mind that every 100 gallons contain 12 degrees of sugar. After the addition of the 16 gallons of spirit there is sugar to the extent of 12 degrees in the 116 gallons of the mixture or $\frac{12 \times 100}{116}$ (10.3) degrees sugar in 100 gallons; the port wine will consequently contain about 10 per cent. sugar.

For making sherry the grapes should be thoroughly ripe. (French grapes are well suited for this purpose) but it should contain not more than 26 per cent. sugar. Run the must from the husks at once. The fresh husks should also be squeezed out to extract the largest possible quantity of must from them. As soon as it starts fermenting, add 2 lb. plaster of paris to every leaguer of must. Thoroughly stir the must every morning, using a long stick with a square wooden board attached to its end, something similar to a ordinary stirrer. When the must has about finished fermenting it is racked into a barrel and allowed to stand over until fermentation has completely stopped. The wine is now tested to determine how much alcohol it contains, and spirit is added to bring it up to 30 degrees P.S. It may then be racked into hogsheads which should only be filled to within a few gallons of their total capacity and should not be closed too tightly.

The hogsheads are then stowed in a cellar or some other place which is not too cold. The wine is not racked again.

Mixing and Applying Guano.

Rustenburg.—How must Government guano be mixed and when and how applied?

School of Agriculture, Potchefstroom, replies: Mix one part guano with three parts super and use 200 lb. per acre of the mixture. Guano is obtainable from the Superintendent, Government Guano Islands, P.O. Box 251, Capetown, but if not procurable use bonemeal instead. The fertilizer attachment to the planter is a good way for applying guano, or you can mix it with soil and broadcast it.

Storing Mealies in Tanks.

Pretoria.—I am not sure how mealies in corrugated-iron tanks would be affected by moisture, or whether tanks each holding (say) 100 to 150 bags is a feasible proposition. Is there any alternative scheme which is not too expensive and will meet the marketing conditions—either in the way of a building in brick and cement for storage in bulk or an open shed of corrugated-iron for bags?

School of Agriculture, Potchefstroom, replies: With regard to storage in corrugated-iron tanks, a 2,000-gallon tank is 8 feet high by 7 feet 3 inches diameter, and holds approximately 80 bags. It must be fitted with an air-tight manhole cover at the top for filling and an air-tight outlet at the bottom for emptying. These tanks are best when under a roof such as that of a stoep.

NOTES FROM THE "GAZETTE."

Attention is drawn to the following matters of interest which appeared in the *Union Government Gazette*:—

(Abbreviations: "Proc."-Proclamation. "G.N."-Government Notice.)

Gazette. No.	Date.	*Items.*
1505 1507	18/9/25 2/10/25	*Crown Lands for Disposal.*—A piece of Crown land, in extent approximately 84 morgen, situate in the District of Worcester, will be offered for sale by public auction at Villiersdorp on the 10th November, 1925. (G.N. No. 1599.)
1506 1507	25/9/25 2/10/25	Certain Crown lands in the District of Caledon will be offered for sale by public auction on the 11th December, 1925. (G.N. No. 1629.) (Plans and general conditions of sale may be seen at the Department of Lands, Pretoria, and at the office of the Magistrate, Caledon.)
1506	25/9/25	Tenders are invited by the Department of Lands for the lease of the Isinuka Springs, together with certain land attaching thereto, in extent about 10 morgen, situate in the Isinuka Valley, District Port St. Johns, Cape, from 1st January, 1926, to 31st December, 1935. Plans of the area may be seen at the office of the Secretary for Lands, Pretoria; at the office of the Surveyor-General, Capetown; and at the office of the Magistrate, Port St. Johns. Tenders should be addressed to the Secretary for Lands, Pretoria. (G.N. No. 1643.)
1507	2/10/25	Particulars regarding the lease of certain holdings in the Transvaal, Districts of Marico, Pietpotgietersrust, and Zoutpansberg are scheduled in G.N. No. 1675.
1507	2/10/25	A certain piece of Crown land (Lot No. 21), in extent 35 morgen, situate in the District of Butterworth, will be offered for sale by public auction at Butterworth on the 5th of December, 1925. (G.N. No. 1701.) The diagram and conditions of sale may be seen at the Department of Lands, Pretoria, and at the office of the Magistrate, Butterworth.
1505 1506 1507	18/9/25 25/9/25 2/10/25	*Dipping.*—The compulsory disinfection and dipping of all horses, mules, and donkeys has been ordered as follows:— Every seven days in the seven-day dip on (*a*) Sahlulo's Location No. 18 and that portion of Elias' Location No. 19 adjoining Location No. 18, Mount Ayliff District, Transkei; (*b*) Locations Nos. 8 and 9, Umzimkulu District, Transkei (G.N. No. 1591); (*c*) George Moshesh's Location, Matatiele District, Transkei; (*d*) Locations Nos. 3, 5, 6, and 7, Umzimkulu District, Transkei (G.N. No. 1648); (*e*) Tsolobeng's Location, Mount Fletcher District, Transkei (G.N. No. 1695).
1505	18/9/25	Every fourteen days in the fourteen-day dip on Mzongwana Location, Matatiele District, Transkei (G.N. No. 1591).
1505	18/9/25	Particulars regarding the dipping of sheep and goats brought into or removed from the Districts of Williston, Van Rhynsdorp, Calvinia, Kenhardt, Gordonia, Fraserburg, Carnarvon, Sutherland, and Namaqualand between certain specified dates are scheduled in G.N. Nos. 1593, 1594, 1595, 1596.
1506	25/9/25	The compulsory disinfection and dipping of all cattle has been ordered as follows: Every three days in the three-day dipping-fluid on Rooikoppies No. 2079, Middelkop No. 2305, Vluchthoek No. 2306, District Pietersburg, Transvaal. (G.N. No. 1649.)
1508	9/10/25	The compulsory dipping of sheep and goats in the District of Kuruman, Cape, has been ordered to take place between 1st November and 31st December, 1925. (G.N. No. 1720.)

Gazette. No.	Date.	Items.
1506	25/9/25	*Fencing.*—Contributions towards the cost of dividing fences have been declared obligatory as follows: (*a*) In Ward No. 31, District Hlabisa, Natal (Proc. No. 222); (*b*) in Ward Zoutpan, Waterberg District (Proc. No. 227).
1507	2/10/25	
1507	2/10/25	Contributions towards the cost of (*a*) converting dividing fences into vermin-proof fences and (*b*) erecting vermin-proof fences as dividing fences has been declared obligatory in the eastern portion of Ward No. 6, Steytlerville District. (Proc. No. 226.)

STAFF: APPOINTMENTS, CHANGES, ETC.

11/5/25 *A. P. v. d. Post*, B.Sc.(Cornell), B.A.(Cape), Assistant Experimentalist, Grootfontein School of Agriculture, appointed Senior Economist in Division of Economics.

1/7/25 *J. H. R. Bisschop*, B.Sc., B.V.Sc., Temporary Field Officer, appointed Research Officer at Onderstepoort.

21/7/25 *C. A. Williams*, Stock Inspector, retired.

25/7/25 *P. S. Snyman*, B.V.Sc., Government Veterinary Officer, Harrismith, transferred to Nongoma.

31/7/25 *E. O. Bowles*, Stock Inspector, retired.

1/8/25 *P. J. v. d. Merwe* appointed Sheep and Wool Expert.

18/8/25 *C. H. Neveling*, B.A., appointed Second Grade Economist in Division of Economics and Markets.

28/8/25 *C. J. van Heerden*, Government Veterinary Officer, Nongoma, transferred to Eshowe.

29/8/25 *F. C. P. Stow*, Sheep and Wool Expert, Bloemfontein, transferred to Kroonstad.

7/9/25 *A. Goodall*, M.R.C.V.S., Senior Veterinary Officer, Queenstown, appointed Assistant Principal Veterinary Officer, Pretoria.

9/9/25 *Dr. A. E. Romyn*, M.Sc., B.S.A., Ph.D., Lecturer in Animal Husbandry, Cedara, appointed Senior Cattle Officer, Division Field and Animal Husbandry.

22/9/25 *A. M. Campbell* appointed Temporary Lecturer in Animal Husbandry at Cedara School of Agriculture.

CITRUS CANKER ERADICATION.

INSPECTION WORK, SEPTEMBER, 1925.

Farms Inspected—

Rustenburg District (Hex River Ward).—Buffelspoort No. 668, Bokfontein No. 647, Modderfontein No. 247, Boschfontein No. 183, Swartkopjes No. 711, Zuurplaat No. 822, Zandfontein No. 548.

Pretoria District (Crocodile River Ward).—De Kroon No. 420, Wildebeesthoek No. 611, Zilikatsnek No. 379, Vissershoek No. 45, Roodekopjes No. 44.

Fresh Outbreaks.—Nil.

Total Number of Nursery Trees Inspected.—10,131.

Total Number of Trees Inspected.—12,802.

Total Number of Trees found Infected.—Nil.

Number of Inspectors Engaged.—14.

JOURNAL OF THE DEPARTMENT OF AGRICULTURE.

VOL. XI. DECEMBER, 1925. No. 6.

Published monthly in English and Afrikaans by the Department of Agriculture Union of South Africa.

SUBSCRIPTION: Within the Union and South-West Africa, 5s. (otherwise 6s.) per annum, post free, payable in advance.
Applications, with subscriptions, to be sent to the Government Printer, Pretoria.

ANNUAL REPORT OF THE SECRETARY FOR AGRICULTURE.

Year ended 30th June, 1925.

Secretary for Agriculture: P. J. du Toit.

1. *Organization of the Department.*—Following upon an inspection by the Public Service Commission, the organization of the Department was considered at a conference, called by the Minister, of all heads of Divisions and principals of Agricultural Schools and the Public Service inspector, in addition to the heads of the secretarial staff. Much divergence of opinion naturally arose. Organization should be neither far in advance nor lag behind the needs of the country, and it would be entirely wrong to set up a model simply because it is a model. Organization should grow out of the experience of the Department and be as far as possible in accord with the immediate requirements of the country; and a cardinal factor should be due recognition of personal claims. A public service commissioner of the Commonwealth of Australia recently wrote:—

"A system which may suit one department may not suit another department. As a rule, the system has to be adapted to the department. . . . Once a system has been installed it should be kept reasonably stable; there may be modifications from time to time to meet expansion, general development, and modern improvements; but change for the mere sake of change should be avoided."

Instead of thirteen Divisions, it was decided to group allied ones into Divisions of Field Husbandry and Animal Husbandry; but until provision could be made by Parliament for two such

Divisions, it was decided to retain them as one. The organization according to the decision taken consists of—

(1) Secretariat.
(2) Division of Veterinary Research. } These two to be amalgamated
(3) Veterinary Field Division. } as soon as practicable.
(4) Division of Animal Husbandry. } Temporarily retained as one.
(5) Division of Field Husbandry. }
(6) Division of Botany.
(7) Division of Entomology.
(8) Division of Chemistry.
(9) Division of Extension.
(10) Five Agricultural Schools with Experiment Stations.

Prior to the conference mentioned, the Minister of Agriculture had already transferred the work of scab eradication to the Veterinary Division and the sheep and wool work to the Division of Field and Animal Husbandry. This accorded with the recommendation of the Public Service inspector.

2. *Division of Economics and Markets.*—This Division was constituted in January, with Dr. F. E. Geldenhuys as chief. A staff of eight technical officers and four clerical assistants has been approved by Parliament, and should be regarded as a nucleus. The Division's functions enter into so many agricultural activities that in order to do the work expected of it, a large staff is necessary, as was pointed out in previous reports. A system of daily market reports will be supplied to all post offices for posting up as soon as the approved appointments have been made. In order to render the market reports of value, it is necessary that the commodities be standardized. Standards are now being fixed.

3. *Agricultural Education.*—The courses of instruction and number of students in attendance at the several Schools of Agriculture during 1924-25 were as under:—*

Description of Course.	Elsenburg	Grootfontein	Potchefstroom	Cedara	Glen.	Total.
Diploma Course	72	52	61	27	89	301
Practical Course	4	1		8	–	13
Special Courses —						
Practical and Oversea Settlers	15	—	3	-	1	19
Sheep and Wool Course ...	-	31		--	—	31
Dairying Course	--	—	—		15	15
Cheesemaking Course... ...	—	-	-	—	10	10
Student Assistants	—	—	5		—	5
TOTAL	91	84	69	35	115	394
Vacation Short Courses	199	346	313	123	406	1,387
GRAND TOTAL ...	290	430	382	158	521	1,781

* This return includes information as at a later date in some instances than that appearing in the individual school reports. In regard to the number of students attending the Winter Vacation Short Courses, the figures embrace the period 22nd June to 31st July, 1925.

Special conferences were held at the Agricultural Schools on the following subjects:—

	Subject.	Attendance.
Elsenburg	Dairymen's Association	60
	Raisin Growers and Packers ...	30
	Poultry Conference	300
Cedara	Dairy Farmers	250
	Poultry Breeders	300
Grootfontein	Woolgrowers' Association	76
Potchefstroom	Maize Breeders	50
Glen	—	—

The inauguration of a system of agricultural teaching in the primary and farm-school curricula by the Departments of Education of the Cape of Good Hope, the Orange Free State, and the Transvaal has necessitated arrangements for the training of teachers in a specified course of agriculture. In the Cape and in the Orange Free State it has been definitely settled that teachers in those schools who desire to qualify shall take the ordinary two years' diploma course, and in all probability the same arrangement will be come to in regard to Transvaal teachers.

4. *Scholarships.*—The following new scholarships for oversea study have been awarded: For field husbandry, 4; for horticulture, 3; for cotton, 3; for animal husbandry, 3; for entomology, 3; for agricultural economics, 2; for sheep and wool, 2. Eight of the scholars have already left, and the remainder are continuing their studies in South Africa before proceeding oversea. Five scholars will soon return to South Africa, having completed their studies; while one is remaining in the United States, having declined an appointment in the Department, which entails a refund of the scholarship money. This, however, is not considered satisfactory, as the State, which has expended a considerable sum, has to select another scholar, and thus loses three to four years' service. It has, therefore, been decided that future scholars who decline a suitable appointment when their studies are completed should be required to refund one and a half times the scholarship.

Six bursaries, ranging from £16. 13s. 4d. to £25, have been awarded at the Agricultural Schools, and also ten bursaries of £50 each to Orange Free State teachers, who are taking the diploma course at Glen Agricultural School in pursuance of the policy of the Orange Free State Education Department to provide for the teaching of agriculture in primary rural schools. The latter bursaries are provided for out of funds set aside by the Orange River Colony before Union.

5. *Extension Work.*—Three trips were undertaken by the demonstration train after overhauling of some of the coaches as the result of experience of the first couple of trips. Thirty districts were visited. On the whole, the attendance was good and enthusiastic, but in a few districts sufficient interest was not displayed. In view, however, of the demand for visits from the train, it cannot be doubted that it is playing an important part in extension work.

Eight extension officers were appointed, and provision has been made for four more. As far as possible the Agricultural Schools

and the Divisions have been drawn upon for extension work, but this can only be done to a limited extent, unless other equally important work has to suffer. A considerable addition to the number of extension officers will, therefore, be necessary to meet the requirements of the country.

6. *Agricultural Co-operation.*—The progress during the year was not as great as during the previous one. At the same time, the forward movement may be regarded as satisfactory. Forty-three new societies were registered, while fourteen were dissolved. Of the latter, the dissolution of five was due to effluxion of time; two to the decision of the members shortly after establishment not to operate; one to re-organization; while three had been inactive for some years.

There are now 272 societies on the register—

With unlimited liability	152,	having	14,793	members.
With limited liability	109,	having	16,229	members.
Consumers' trading societies ...	11,	with	8,782	members.
	272		39,804	

An event of importance was a short visit by Sir Horace Plunkett to South Africa to ascertain in what way he could be helpful to agricultural co-operation in South Africa and to offer the services of the Horace Plunkett Foundation, established during the first year of the Wembley Exhibition at an important conference of representatives of Great Britain, Ireland, and the Dominions. His unique experience, enthusiasm and outstanding success in organizing agricultural co-operation in Ireland gave his utterances exceptional weight and value. His advice as to the lines that should be followed to create a sound structure was sought. He is a forceful opponent of anything which savours of compulsion in co-operation, even to the extent of not compelling members to sell through their own societies. Lack of knowledge of the true principles of co-operation is very evident in South Africa. Compulsion has a great attraction for a large number of co-operators. It is the line of least resistance. Because very special circumstances have induced successive Governments to introduce in legislation a guarded form of compulsion, a considerable section of co-operators believe that it is the panacea for all their ills. It is the present writer's firm conviction that serious harm would be done to the movement if farmers are encouraged to rely on legislation rather than on their own efforts to secure the adhesion of their fellow-producers. They would also be introducing an element of disruption in existing organizations, and opposition and discouragement to projected ones.

7. *Wool and Mohair.*—The number of sheep and goats in the Union was 40,067,000 in 1924 as against 39,467,000 in 1923. These numbers are made up as follows:-

	Sheep.		Goats.	
	Woolled.	Non-Woolled.	Angora.	Other.
1923 ...	25,676,000	5,547,000	2,271,000	5,973,000
1924 ...	26,937,000	5,066,000	2,127,000	5,937,000

The quantity of wool exported was:—

1924–25.		1923–24.	
Quantity.	Value.	Quantity.	Value.
162,403,000 lb.	£14,616,000	162,738,000 lb.	£12,876,000

The quantity of mohair exported was:—

1924–25.		1923–24.	
Quantity.	Value.	Quantity.	Value.
11,611,000 lb.	£937,000	16,087,000 lb.	£1,114,000

A reallocation has been made of the areas served by sheep and wool experts with a view to securing a better distribution of work.

The wool industry suffered a set-back in the beginning of 1925. Various reasons were given, the main ones being the fall in the value of the franc, making business difficult for French buyers; the low purchasing power of Germany; abstention of the United States of America; and inability of Bradford manufacturers to cope with the late high prices. The chief reason appears to be that given last. Prices for the raw article were too high, and buyers of cloth held off because their customers could not afford to buy to the same extent as before. The rise in values is shown in the following table of local quotations:—

	December, 1922.	December. 1923.	December. 1924.
	Price per lb.	Price per lb.	Price per lb.
Extra super combing 12 months, skirted choice	20¾d.	22½d. to 26d.	28d. to 35d.
Super combing 12 months skirted	19½d.	21½d. to 22d.	26d. to 30d.
Super combing 12 to 14 months' growth, skirted, deep stapled	19½d.	21½d. to 22d.	26d. to 30d.
Good average combing 12 months' growth ...	16½d.	18¾d. to 20d.	22d. to 25½d.
Superior combing 10 to 12 months' growth, skirted	16½d.	18d. to 20d.	22d. to 25½d.
Average combing 10 to 12 months' growth ...	14d.	16d. to 17d.	20d. to 21½d.
Extra super medium 8 to 10 months' growth, well skirted	16d.	17d. to 19d.	24d. to 30d.
Average medium 8 to 10 months	12½d.	15d. to 17d.	20d. to 23d.
Superfine shorts 8 months and less, skirted ...	14½d.	17d. to 18d.	22d. to 24d.
Good average shorts 8 months and less, skirted	14d.	15½d. to 16½d.	18d. to 21d.
Average shorts 8 months and less	12½d.	14d. to 15d.	15d. to 17½d.

After negotiations over a long period, Angora goat-breeders succeeded in arranging for the shipment of 117 rams to the United States of America. This is the first effort to find a market oversea. The goats were shipped in April and were sold in Texas in June.

The average price realized was £60. In view of the strenuous opposition at the time against exportation, owing to the fear that competition by the United States with South Africa would be facilitated at the expense of our own industry, it may be stated that reliable information is to the effect that the United States has some rams and ewes equal, and in some respects superior, to South African.

8. *Wool Growers' Associations.*—These associations now number 35. They are not co-operative societies in the sense defined in Act No. 28 of 1922 in that they do not sell on behalf of their members. They exist for the purpose of enforcing correct skirting, classing, and packing of wool in order to secure a good name for their members by winning the confidence of buyers, and are doing valuable work. A national wool growers' association is being formed, to which the local associations will be affiliated.

9. *Scab in Sheep and Goats.*—An important change in the organization was made by the incorporation of the administrative work with that of other veterinary field work; in other words, by placing eradicative measures under the control of the veterinary authorities instead of under a separate Division divorced from veterinary control. The effect has been to place the district supervision under the veterinary surgeons where the distribution of the veterinary staff for other work permitted and to continue supervision by senior sheep inspectors in those districts in which veterinary surgeons are not available The change in policy led to the retirement of 8 senior sheep inspectors and to placing district supervision under 35 veterinary surgeons and 18 senior sheep inspectors, instead of 26 senior sheep inspectors only. The control of inspectors should, therefore, be far more effective. This has already been proved by the detection of infection in a number of centres which were supposed to be free from scab. The practice now followed is that which has been successful in connexion with East Coast fever, namely, close supervision by inspectors over farmers and equally close supervision by senior officers over inspectors. It should be seriously considered by the public whether it would not be better to spend a good deal more on supervision over a few years than a smaller amount over many years. The writer believes that a large amount of money would be saved if the former course were adopted. There is no longer any question that some sheep inspectors have not furnished true returns. A greater number of dismissals has taken place on this account since the change than in previous years.

Simultaneous dipping was carried out this year over the whole of the Transvaal, the whole of Natal, and two districts of the Orange Free State, of all small stock, in addition to the dipping of flocks in which infection had appeared during the previous twelve months in other districts of the Orange Free State and in some of the districts of the Cape Province. The dipping of sheep which had been free from scab for more than twelve months was strongly opposed by a number of farmers, but there is good reason to believe that the great majority were in favour of the dipping of all sheep and goats in an earnest endeavour to make appreciable progress in eradication. This step was also necessitated by the well-grounded suspicion that there was more infection than was shown on inspectors' returns, owing both to infection hidden by some farmers and to incomplete

returns by some of the inspectors. The decision was a wise one in the circumstances, more especially as it was necessary to discover to what extent infection actually existed. Only the dipping of all sheep and goats would indicate this.

Under the new policy, sheep inspectors also undertook to supervise the dipping of cattle within their areas and similarly cattle dipping inspectors undertook the inspection of sheep and goats for scab, the effect of which is to decrease the size of the areas controlled by inspectors.

10. *Anthrax.*—The general position has greatly improved. The number of outbreaks in the various Provinces was as follows compared to those of the previous year:—

	1923–34.	1924–25.
Orange Free State	263	192
Transvaal	579	399
Natal	114	90
Cape of Good Hope	800	533

During the year no fewer than 926,438 animals were inoculated.

11. *Wireworm.*—The Director of Veterinary Education and Research remarks that "as soon as it was realized that we were likely to have a particularly wet summer season, farmers were warned that parasitic diseases of sheep were likely to become troublesome and that more extensive use of the wireworm remedy should be made." Those who only used the remedy spasmodically suffered serious losses. Attention is also drawn to his remarks regarding the need for inoculating early and frequently throughout summer. The number of doses issued was 11,634,400 as against 6,008,900 the previous year.

12. *Blue-tongue.*—Owing to the extremely wet summer this disease was exceptionally severe. The usual delay, on the part of many, in applying preventive treatment was noticeable, with the result that when losses began to occur, applications for vaccines became so numerous that a night and a day staff had to be maintained for producing vaccine, and even then a slight delay occurred for a short period in satisfying the demand. The number of doses supplied was 2,392,800, being an increase of over 1,000,000 on the previous year's issue.

13. *Vaccines.*—The policy of the Department is to supply vaccines and sera as far as possible at cost price. In view of the large demand for blue-tongue and wireworm remedies the cost was brought down from 1½d. to ½d. per dose for the former and from 1s. 6d. to 1s. per 100 doses for the latter, representing on the number of doses supplied during the year a reduction of £9,970 and £2,908 respectively. Owing, however, to the larger quantities issued the revenue was £11,716 and £500 more than the previous year.

14. *Dairying.*—This industry is by no means in a healthy condition. While admittedly the season has not been a favourable one, the general feeling is that there is something seriously wrong with the industry; and unquestionably this is so. This is no new discovery, the only difference being that more people have arrived at this conclusion. Farmers blame the factories; factories blame the farmers and the seasons; and the consumers do not know whom to blame.

In these circumstances it is proper that there should be a thorough investigation into the whole of the industry, and the Board of Trade and Industries has accordingly been requested by the Minister of Agriculture to make a complete investigation with the aid of technical officers of this Department. Without desiring to prejudge the findings of the board, it may be said that there are two outstanding factors which have operated for a considerable time to the detriment of the industry: one being an excessive number of creameries and the other an excessive number of unprofitable cows. Fewer creameries would give the farmers better prices; more cream will put the factories in a better position to reduce costs. But a greater yield of milk, whatever the shortcomings of the creameries may be, is obviously the first reform that should be looked for.

In this connexion it is disappointing to find that milk-recording, with a view to weeding out unprofitable cows and placing milk and cream production on a business footing, is not making more rapid progress. During the past two years the number of farmers who took advantage of the scheme and the number of cows tested were as follows:—

	1924-25.	1923-24.
Farmers	83	59
Cows tested	700	500

The production of butter and of cheese, according to latest available statistics, was as follows:—

Year.	Farm Production.	Factory Production.
	BUTTER.	
1922-23	10,551,000 lb.	11,863,000 lb.
1923-24	9,586,000 lb.	11,104,000 lb.
	CHEESE.	
1922-23	548,000 lb.	5,112,000 lb.
1923-24	444,000 lb.	5,455,000 lb.

Excessive rains disadvantageously affected production in 1924-25. Census figures for the year are not yet available in respect of farm production. According to Census quarterly returns, factory production for the twelve months ended 30th June, 1925, was: Butter, 11,925,000 lb.; cheese, 5,340,000 lb.

It is very satisfactory to be able to record a great increase in applications for the grading of cheese for local consumption, the quantity so graded being 3,593,551 lb. as against 1,624,422 lb. for the previous year.

15. *Cattle Industry.*—The number of cattle in the Union in 1924 was 9,606,274 as against 9,315,182 in 1923. For the first time the Census Office has obtained separate returns of all Native-owned cattle and all European-owned. On previous occasions the only distinction was between cattle in native reserves and locations and cattle on European-owned farms. The number of European-owned cattle and Native-owned is:—

	European-owned.	Native-owned.
1924	5,369,770	4,236,504
1923	5,365,736	3,949,446

It will be seen that while the European-owned cattle remained more or less stationary in number, the Native-owned cattle increased by 287,000.

16. *Export of Meat.*—The opening up by the Imperial Cold Storage of a market for South African frozen meat in Italy has led to a considerable improvement in the export trade, 118,001 quarters being exported during the year. During the previous year the figure was 34,891 quarters.

The British Government permitted the importation from South Africa of live cattle if landed and slaughtered at Birkenhead. The Imperial Cold Storage took advantage of this by sending several consignments from South-West Africa; and Mr. Stewart, of Southern Rhodesia, also took over a shipment.

The British Government has also, in fulfilment of its undertaking at the Economic Conference held in London in October, 1923, obtained Parliamentary sanction of the importation (under veterinary safeguards) of pedigree live stock from the Dominions, which previously could only be done by special permission in exceptional circumstances.

17. *Cattle Imported from Adjoining Territories.*—The annulment by the Union Government of the Customs Convention between Southern and Northern Rhodesia and the Union, followed by a conference of Ministers representing the two territories, was made the occasion for considering the conditions on which cattle were permitted to enter the Union from Southern Rhodesia. A new convention became effective from the 1st January, 1925, and thereunder Rhodesian slaughter cattle entering the Union are required to be of a minimum weight of 1,050 lb. for oxen and 790 lb. for cows or heifers at the point of dispatch in Rhodesia, and 1,000 and 750 lb. respectively on arrival in the Union. By arrangement with the Rhodesian Government, which has met with readiness and promptitude the requirements of this Government as regards enforcing the restriction, all cattle are weighed individually either where they are entrained or on the Limpopo River at Main Drift or Liebig's Drift. During the two last years the importations of slaughter cattle from adjoining territories were:—

	1923-24.	1924-25.
Southern Rhodesia	41,716	19,250
Bechuanaland Protectorate	47,143	35,626
South-West Africa	47,047	27,209
Swaziland	5,465	9,814
Basutoland	—	—
Total	141,371	91,899

During the six months 1st January to 30th June, 1925, the importations from Southern Rhodesia and the Protectorate for the same two years were as follows:—

	1923–24 (Six months).	1924–25 (Six months).
Southern Rhodesia	17,856	985
Bechuanaland Protectorate	19,219	20,434

The importation of cattle from other adjoining territories is receiving attention. Definite steps will be taken at the end of the calendar year.

18. *East Coast Fever.*—The progress made with the eradication of this disease is indicated by the following:—

—	Number of Outbreaks.		
	1922-23.	1923-24.	1924-25.
Natal	140	120	60
Transvaal	20	6	11
Transkeian Territories	15	12	5

The number of centres still in quarantine is 157 in Natal, 17 in the Transvaal, and 22 in the Transkei, as against 257, 30, and 58 respectively in 1923-24. Infection exists in the Transvaal in five districts, indicating that the disease is well under control. The very satisfactory position reached is due to the stricter supervision which the Veterinary Division has been able to exercise by augmentation of its field staff. The policy of constant vigilance and close supervision always advocated by the Principal Veterinary Officer, although expensive, is proved to be the cheapest in the long run, being the most effective. The number of inspectors employed on this work is 320, distributed as follows:—

	1923-24.	1924-25.
Natal	158	175
Transvaal	106	91
Transkeian Territories	50	54
	314	320

19. *Nagana.*—The tsetse-fly investigations continue. Meanwhile, Dr. Berg, of Bayer Company, has demonstrated that Bayer 205 in combination with tartar emetic conferred an appreciable protection on cattle and other animals. The Director of Veterinary Education and Research remarks that while the method may not be practicable on a large scale, it certainly affords a means of protecting animals for a considerable period.

The controversy regarding the effect of the game reserves in Zululand on the prevalence of Nagana still continues. Both the Veterinary Research and the Entomology Divisions are strongly in favour of the game reserves being abolished, but the Provincial Administration believes that the case against the reserves has not been proved and is definitely opposed to their abolition.

20. *Ostrich Feather Industry.*—After an advance in the latter half of 1923 of £8,000—recently increased to £10,500—for propaganda and advertisement in Paris, London, and New York, it was thought by the committees appointed in those cities that there were clear indications of some measure of revival of trade. There was, in fact, a slight but short-lived improvement. At present the industry

is in lower depths than ever, and little hope is felt anywhere of a sustained recovery. The farmers in Oudtshoorn and neighbouring districts are now asking—many years too late—to what other industry they can turn their attention. An investigation has been ordered by the Minister of Agriculture.

21. *Poultry Industry.*—The export trade in eggs continues to make satisfactory progress, the number of boxes exported in 1923 being 53,371 of 30 dozen each, while in 1924 the number reached 76,281. The need for more itinerant instruction is felt. The Department holds that it is very desirable that officers appointed for such work be given the highest training. The offer of two scholarships for oversea study is, therefore, being considered.

An event of importance in the industry is the inauguration of an international egg-laying test by the Agricultural Society of Port Elizabeth.

Instead of two egg-laying tests conducted by the Department, one at Potchefstroom and one at Cedara Agricultural School, it has been decided to have a central test at Glen from May next, which test also will be open to all countries.

22. *Wheat and Maize Experiment Stations.*—Parliament has voted funds for a wheat experiment station and a maize experiment station, both of which the Department has had in view for some time. The former will be in the main wheat-growing area, probably in the District of Malmesbury, and the latter in the Northern Orange Free State, well within the principal maize-belt. The wheat lands of the South-West have been deteriorating over a long period of years, and the problem of restoring those lands to greater fertility will be no easy one to solve. It will probably take a good few years to arrive at definite results. The South-West produces approximately 1,000,000 bags of wheat out of a total consumption of about 3,600,000 bags, and the production per acre is only 8½ bushels against that shown below in respect of other countries, viz.:—

	Average Yield in Bushels per Acre, 1919–21.		Average Yield in Bushels per Acre, 1919–21.
Denmark	46·37	China	14·03‡
Netherlands	39·76	Bulgaria	13·54
Belgium	35·66	Rumania	13·35
Switzerland	31·10	Spain	13·31
United Kingdom	31·06	United States	13·10
New Zealand	30·88	Jugo-Slavia	13·06†
Sweden	30·12	Australia	12·73
Germany	26·57	Canada	12·66
Egypt	24·89	Argentine Republic	12·02
Turkey-in-Asia	22·12*	India	11·42
Japan	21·82	Korea	11·23
Turkey-in-Europe	20·97*	Russia-in-Europe	10·85§
Czecho-Slovakia	20·33	Uruguay	10·79
France	19·92	Greece	10·27
Chile	17·75	French Morocco	9·49
Hungary	16·33†	Russia-in-Asia	8·92§
Lithuania	15·40	Algeria	8·21
Austria	15·34	Portugal	8·07
Poland	15·34	Mexico	6·24*
Italy	14·97	Tunis	5·41

* Single year. † Average for two years. ‡ Year 1914. § Average 1909–13.

It is an easy calculation to ascertain what doubling the yield per acre would save the country by diverting the amount spent in importation into the pockets of the South African producer. Even if the yield per acre is not greatly increased, the view is strongly held that a different system of farming in addition to improved methods—for instance, a system of diversified farming—would give the farmer of the South-West an appreciably larger return.

The maize experiment station does not present the same problem, that is, restoration of the soil, but rather how seed selection and good tillage in addition to a suitable manurial system will enhance the yield. Many farmers are now receiving satisfactory yields, but the average per acre of about 2½ bags for the European farmers is a matter that the country can only view with the greatest concern. The average should easily be doubled and bring in from £5,000,000 to £10,000,000 per annum (according to season) more than at present. In addition to carrying out experiments. it is proposed to demonstrate the results in a complete system of maize farming on the station.

23. *Boys' Maize-growing Competition.*—There are now 650 entrants against 600 the previous year. The educational value of such a competition is so great that an earnest effort is being made to establish boys' and girls' clubs in respect of other agricultural produce as well.

24. *Pure Seed Societies.*—The Division of Field and Animal Husbandry has been instrumental in forming a potato seed society in the Orange Free State, and 4 maize seed societies, two in the Transvaal and 2 in Natal. The object of these societies is to supply buyers with guaranteed pure seed inspected, both during the growing period and after reaping, by qualified men specially appointed for the purpose, who issue certificates in respect of approved seed.

25. *Sugar Experiment Station.*—Considerable delay occurred in the selection of a suitable site. A final selection has now been made at Mount Edgecombe, Natal Province.

26. *Diseases of Maize and Sugar-cane.*—Valuable work has been done by Mr. Storey, Mycologist in the Division of Botany, on streak disease of maize and sugar-cane by showing that it is caused by insect transmission. He has also prosecuted his work on *Mosaic* disease of sugar-cane.

As stated in the previous Annual Report, the question of eradication has been contemplated. Probably such a measure will be carried out in Zululand, the results of which will be watched as a guide to future action.

The provision of a quarantine green-house by the Sugar Association is gratefully acknowledged in connexion with the importation of new varieties of cane.

27. *Dr. Webber's Visit.*—The visit has to be recorded of Dr. H. J. Webber, Professor of Sub-tropical Horticulture and Director, Citrus Experiment Station, California, from October, 1924, to May, 1925, which embraced both the Union and Southern Rhodesia. Mr. C. P. Lounsbury, Chief, Division of Entomology, was in the United States of America in 1922. He invited Dr. Webber to spend his projected long leave in South Africa, believing that the Union would

greatly benefit by such a visit. On Mr. Lounsbury's recommendation the Union Government extended a formal invitation to Dr. Webber, who accepted it. Dr. Webber's knowledge of citrus is probably unsurpassed. Wherever he travelled he greatly impressed the citrus growers. His report, which has been published as a special bulletin,* contains evidence throughout of the care with which he has examined our problems and the fullness of the service he has been able to render. His report, moreover, contains the very latest in scientific results and is, therefore, more up to date than any other published work.

Dr. Webber has also been able to render other very valuable service by freely giving his ripe experience of agricultural education and departmental organization as well as cotton culture.

28. *Fruit Export.*—A new feature in the export trade has been the carrying out of extensive experiments in the transportation of deciduous fruit from the Transvaal to the coast for export. Several types of refrigerator car were constructed by the Railways Administration on the advice of Mr. Griffiths, the Government Physicist. It has been shown that deciduous fruit pre-cooled in the Transvaal and transported in refrigerator car can be exported with profit. Assuming suitable seasons, the experiment opens up a larger area for the deciduous export trade.

The rapid growth of the citrus export trade, the seasonal variations, and the need, as the trade grows, for extending the export period for citrus into the late ripening season, will probably necessitate the provision of cold storage accommodation inland in the near future. Such accommodation would meet also the needs of the deciduous fruit industry.

The export of fruit during the past twelve months has been as follows, compared with the previous period:—

	1924-25.	1923-24.
Deciduous and other non-citrus	1,497,181 boxes	977,845 boxes.
Citrus	450,218 boxes	373,785 boxes.
Pineapples	68,464 boxes	48,687 boxes.
	2,015,863	1,400,317

29. *Cold Storage Researches* in connexion with fruit, especially with regard to the export trade, are being continued. Attention is invited to the report of the Chief, Division of Botany. Important work is being done for the fruit farmer.

30. *Citrus Canker.*—Notwithstanding diligent watch throughout the infected area for recurrence of citrus canker, no case was discovered for a little over three years in orchards previously affected. Unfortunately, the discovery was made at De Kroon, in Pretoria District, in March, 1925, of one infected tree, at a spot where three had been eradicated in 1918 to 1919. This case has afforded ample proof, apart from the repeated recurrences of the infection in the Department's experiment plot, that the policy advocated and carried

* "A Comparative Study of the Citrus Industry in South Africa." Obtainable from this office: price, 2s. prepaid.

out by the Division of Botany, both as regards inspection and preventive measures, has been the right one. There is no conclusive evidence yet of the maximum period during which infection remains present.

31. *Chemistry.*—The Division of Chemistry has conducted a number of valuable researches and investigations in addition to the ordinary routine analyses. The soil work of the Division is assuming greater importance. No important irrigation scheme is now undertaken without a chemical survey of the area which will be brought under irrigation. The co-ordination of the chemical work at the three main laboratories and the five Agricultural School laboratories is yielding the satisfactory results anticipated. as a reference to the detailed report of the Acting Chief of the Division shows.

This portion of my report cannot be closed without reference to the termination, on account of pensionable age, of the long association of Dr. C. F. Juritz with the Division almost since the inception of a Government chemical laboratory in the Union. His work, both in the Department and outside of it, and his keen interest in scientific organizations are well known and appreciated, and he has left behind a splendid record of achievement and seen the fulfilment of his idea, advocated and fought for for many years, that all analytical chemical work in the Union should be organized into one whole for the more effective co-ordination of each section.

32. *Viticulture.*—The Co-operative Wine Farmers' Association of South Africa has at last found itself in a position to embark on two definite undertakings for the improvement of the industry, one being provision for maturing wine for export and the other the erection of pot-stills for the distillation of brandy, which can be matured for both the local and, if possible, the oversea market. Hitherto the trade in both wine and brandy has been practically confined to South Africa. As has frequently been pointed out, the industry can be placed in a sound position only by extending the market; and the direction for doing so is oversea alone. The association has also financially supported greater production of raisins and grape syrup as further outlets. The opening made by Mr. Spilhaus, when Commissioner of Commerce, on the Continent of Europe, for exportation of heavy wines to Germany, though on a small scale, seems to indicate ultimate success.

The *Wine Control Act*, passed by Parliament in 1924, enabled the association, by obtaining complete control, to fix a substantially higher price for distilling wine. The result has been a great demand for grafted vines. Good wines sold at from £5 to £8 per leaguer. The production was about 113,000 leaguers compared to 95,000 in 1924. Since the passage of the Act mentioned, the following procedure obtains: The members of the association are free to sell direct to merchants or other buyers all classes of wine. The price of distilling wine is, however, fixed by the association, the price this year being £7. 18s. 9d. per leaguer, and payment has to be made by the buyer through the association, which pays the farmer £4. 15s. and retains £3. 3s. 9d. per leaguer, the latter amount going to a fund controlled by the association for distillation of wine, storage for export, etc. The association pays out of that fund also—

(*a*) a bonus of ½d. per lb. for raisins made with the object of keeping down the production of wine; and

(*b*) £1 per leaguer for wine made into vinegar in order to compete with vinegar made from other sources, as, for example, Natal sugar-spirit.

The lease of Groot Constantia is still under consideration.

33. *Adulteration of Wine, Spirit, and Vinegar.*—During the year 1st July, 1924, to 30th June, 1925, 509 samples were purchased for analysis in terms of Act No. 15 of 1913. in the following centres, viz.:—

Cape.—Aberdeen, Bredasdorp, Britstown, Burghersdorp, Calitzdorp, Calvinia, Cape Town, Clanwilliam, Colesberg, Douglas, Elliot, Fraserburg, Grahamstown, Griquatown, Hopetown, Humansdorp, King William's Town, Ladismith, Montagu, Peddie, Prieska, Prince Albert, Stutterheim, Willowmore.

Natal.—Bulwer, Durban, Harding, Ixopo, Weenen.

Transvaal.—Belfast, Bethal, Bloemhof, Carolina, Christiana, Louis Trichardt, Lydenburg, Pietersburg, Piet Retief, Pilgrims Rest, Schweizer Reneke, Ventersdorp, Zeerust.

Orange Free State.—Fauresmith, Ficksburg, Heilbron, Hoopstad, Ladybrand, Philippolis, Rouxville, Smithfield, Vrede, Winburg.

The following were the results of the analyses and subsequent prosecutions:—

Article.	Number of Samples Purchased.	Adulterated or Deficient.	Incorrectly Labelled.	Number of Prosecutions (by samples).	Number of Convictions (by samples).
Wine	6	—	—	—	—
Brandy	253	13	19	16	12
Whisky	147	2	19	6	5
Gin	93	2	11	3	2
Vinegar	10	1	1	—	—
TOTAL	509	18	50	25	19

In addition to the 509 samples purchased in the Union and referred to above, 145 samples were analysed on importation, with the results shown hereunder:—

Article.	Number of Samples.	Adulterated or Deficient.	Incorrectly Labelled.	Refused Admission into the Union.
Wine	83	3	4	1
Brandy	11	3	1	—
Whisky	41	—	1	—
Gin	2	—	—	—
Vinegar	8	—	—	—
TOTAL	145	6	6	1

34. *Cotton.*—The work of the officers of the Empire Cotton Corporation is bearing early and important results. The Jassid, a very small winged bug, does serious damage in the low veld. Mr. Parnell has been giving special attention to the pest, whose attacks vary with the susceptibility of the variety of cotton. Of imported varieties tried, Cambodia shows complete immunity. A single plant selection out of Zululand Hybrid was found definitely resistant to Jassid, and Mr. Parnell proposes to improve still further and to multiply this strain. He has every reason for hoping "that the Jassid problem will be solved satisfactorily in the very near future, thus removing one of the most serious obstacles to the successful development of cotton growing in the low veld areas."

Insect pests are occasioning large losses, particularly the Soudan boll-worm. Two young entomologists were supplied by the Imperial Cotton Growing Corporation, working under an experienced entomologist of the Department, who, however, was engaged on other duties as well. The alarming spread of insect pests has necessitated a decision to engage two more entomologists from oversea, and to keep the senior entomologist referred to entirely to this work. It is hoped, therefore, in the near future to have five entomologists employed on cotton work. This number may be considered to be out of proportion to the value of the crop, but as the industry is in its infancy and has great potentialities, and also as a considerable area of land has either changed hands or been settled for the purpose of cotton growing, the course decided upon is considered to be justified.

A very large increase in the crop was expected this year, but the cotton lands unfortunately suffered severely from floods and insect attacks. It is, however, anticipated that the output of the past year will be more than double that of the previous season, which was 3,492,000 lb. of lint.

In association with the staff of the Empire Cotton Growing Corporation, 18 cotton fertilizer experiments are being conducted: 6 in Natal, 9 in the Transvaal, and 3 in the Cape Province. The Corporation has allocated 4 scholarships for advanced study of cotton (2 senior and 2 junior). The senior scholarships have been awarded; the 2 junior ones are still under offer.

Three scholarships for study in the grading of cotton have also been awarded out of the cotton levy fund.

35. *Apprentices, Rustenburg Experiment Station.*—Owing to the great demand for the training of apprentices in tobacco and cotton growing, the approval of Parliament was obtained to extension of the accommodation so as to provide for 48 instead of 12. The new hostel will be completed at the end of 1925.

36. *Wildfire in Tobacco* continues to receive special attention from various aspects.

37. *Rosette Disease of Peanuts.*—Mr. Storey has demonstrated that this disease is disseminated by a species of aphis. This must be regarded, however, as only a first stage in dealing with the question.

38. *Plant Importation.*—For the more effective fumigation of imported plants, the Division of Entomology is having a vacuum

disinfector installed at Durban and at Cape Town. Provision has also been made for a green-house and quarantine station for imported plants at Elsenburg; and a new inspection building will shortly be built at Cape Town Docks to replace the present structure.

39. *Vermin-proof Fencing.*—Contributions to this class of fencing have been declared compulsory in 16 districts and 17 portions of other districts, all in the Cape Province. The beneficial results to the sheep and wool industry and to the veld should be marked within a comparatively short period.

40. *Locusts.*—Towards the end of the previous season it was thought that the worst of the cycle was over, but heavy rains in the Kalahari and severe infestation in that region caused a repetition on an intensified scale of the 1923 invasion. At the end of the season it was, therefore, clear that a campaign at least as carefully planned and as vigorous as the previous one would have to be undertaken in the season just past. The senior officers were called together to exchange experiences and make suggestions regarding the future work. It appears clear that as the Kalahari was the source from which all undoing of a vast amount of labour and expenditure could be expected from time to time, more should be known about the desert in order that the enemy might be fought at close or closer quarters not only in the inhabited regions, but also in the uninhabited. Whether the investigations showed that the infestation in the Kalahari was due to migration into it from other parts, or the infestation of other areas was due to migration from the Kalahari, and whatever might be learnt in the future about the life-history of the locust, its habits, the best means to destroy it, and its natural enemies, it was clear that the plague would always have to be attacked wherever it might be found. An expedition into the Kalahari was, therefore, organized of administrative, technical, and field officers, and valuable information was obtained. The mission's report was published, and it is not necessary to repeat the recommendations made. It was made manifest, however, that the campaign could be extended over a greater area than was previously possible: and a more complete organization in the Protectorate was brought into being. A further result was the desirability to concentrate motor-lorries on the near edge of the desert to deal with swarms about to penetrate into the Union. The research work foreshadowed last year, and which has been entrusted to the senior entomologist and one of the Agricultural School entomologists, has also been facilitated.

It should be recorded that the Transvaal Consolidated Lands brought into use on its property in the Western Transvaal a motor-lorry sprayer which indicated the practicability of rapid and effective destruction where locusts appeared in great masses. While the machine was used against fliers, it served to show the possibilities of machine spraying of "voetgangers." Nine such motor-lorries were brought into use during the past season by the Department, and very effective work was done in the areas bordering on the Kalahari as well as in some localities inland.

Natural enemies of the locust appeared over a wide area and largely assisted in the work of destruction. The first observed was the fly that deposits a maggot at the back of the neck of the locust: the second, a fungous growth on locusts in the northern districts

of South-West Africa and in the Western Protectorate, which, however, continued only while incessant rains fell; and the third, a fly which deposits its eggs in locust-egg pockets. These egg deposits were observed in Prince Albert, Middelburg, and other Karroo districts.

The number of swarms destroyed was 902,270, distributed as follows:—

	1924-25.	1923-24.
In the Union	832,896	818,425
Bechuanaland Protectorate	33,575	42,777
South-West Africa	86,900	100,000
	953,371	961,202

The expenditure incurred in the two years amounted to:—

1924-25.	1923-24.
£377,214	£324,726.

Appreciation has to be expressed of the manner in which the staff performed their work and also of the loyal support given by the farmers. The brunt of the campaign always falls on the western districts, especially those nearest the Kalahari desert, and one's sympathy goes out to those who have to wage war on inroads from time to time. It is not surprising that an appeal has been made from many quarters that all expenses in connexion with the destruction should be paid from public funds. Such a policy, however, is manifestly impossible. The destruction of locusts by persons on whose farms they appear cannot be regarded in a different light to the combating of a stock disease like East Coast fever or a plant disease like Citrus Canker or Wildfire. The prospects for the coming season are far brighter. Very small areas of the Transvaal and the Orange Free State are likely to be affected, and in the Cape only the north-western districts and a few scattered ones show indications of egg deposits. In Bechuanaland Protectorate and South-West Africa also the campaign will probably be confined to small portions.

The work in South-West Africa has shown the desirability of bringing locust destruction in that Territory under complete Union control, and it has been arranged, with the consent of the Administrator, that the work next season will be conducted from Union headquarters and under Union supervision, local men being, however, engaged as far as possible. This arrangement is no reflection on South-West Africa officials; but it is clear that a single control must have better results than the system followed in the past couple of years.

41. *Eucalyptus Snout-beetle.*—In my last report mention was made of the appearance of this serious tree pest in King William's Town and Pietermaritzburg Districts. Since then it has been discovered to be widespread over the gum plantations of the Witwatersrand. The Chief of the Division of Entomology is endeavouring to arrange with the Government of New Zealand, which country is also affected, for a search of natural enemies of the beetle in Australia, where it

would appear the insect is suppressed. Such a course, which he has had in mind for several years, could not be undertaken owing to shortage of his own staff. He also proposes to carry out with the assistance of the Director of Air Service during the forthcoming summer, aeroplane dusting of affected plantations as an experiment.

42. *Research Work.*—Only certain items of research work have been referred to by me. Reference is suggested to the various annexures for information regarding the very large amount of important investigational and experimental work being undertaken by the Divisions and Schools of Agriculture.

43. *Wattle Bark.*—This industry has received an impetus as the result of higher prices and, at the same time, a favourable season. Not only has the rainfall been exceptionally good, but the bagworm pest has been kept in check. The principal export used to be to Germany, but more and more wattle bark and extract are being consumed in Great Britain, due to contraction of the available supplies of quebracho, which the British market favoured. The wattle bark industry would, therefore, appear to have a promising future.

44. *Guano Islands.*—The quantity of guano collected was 8,521 tons in 1924 compared with 10,096 tons in 1923. The 1925 crop also is expected to be a small one, apparently owing to scarcity of small fish, which, of course, forms the food supply of the birds. The cost of production for 1924 was £5. 10s. 7d. per ton and for the previous year £4. 19s.

The number of sealskins secured was:—

	No.	Average Value.	Total Receipts.
1924	10,500	£1 17 7	£18,291
1923	11,223	£1 9 0	£16,148

The profits from the Guano Islands were £31,482 in 1924-25 and £5,721 in 1923-24.

45. *Drought Distress Relief.*—The provisions of the Act of 1924 were explained in my last Annual Report. The number of applications received by the Land Bank to 31st May, 1924, was:—

Cape of Good Hope	1,742
Orange Free State	1,736
Transvaal	5,491
	8,969

Of these, 5,921 have so far been granted, the amount involved being £435,064.

A few districts in the Cape Province, to which the Act was extended this year, are still being dealt with.

46. *Publications.*—An important departure has been made in the publication of an advice letter weekly with a distribution of 10,000 copies. It is a succinct statement of important facts which all farmers should be acquainted with, and its construction is such as to fix attention on the main features. The appearance of this letter has been welcomed by a large circle and is believed to be of educational value.

The formation of a Publicity Committee within the Department, though constituted in the previous year, commenced to function this year only. It has led to a decision to bring about a change in the Department's monthly *Journal*, which in the near future will be issued monthly in a popular form and quarterly in its present form. It is hoped that the change to the popular form will bring about greater appreciation among farmers of the special articles published from time to time.

An improvement in the finances of the country will also enable the Department to undertake the publication of a farmers' handbook, which has been in contemplation for some years.

The number of copies of the *Journal* circulated monthly is 10,400, of which 7,500 are in English and 2,900 in Afrikaans. Of that number, 7,490 copies are issued free (5,160 in English and 2,330 in Afrikaans), of which 4,050 go to correspondents in return for free services as monthly crop reporters. The number of subscribers to the *Journal* is, therefore, approximately 2,500 (2,000 in English and 500 in Afrikaans). The total revenue for the year was £1,740 and the cost £5,680, including the free issue to crop correspondents.

47. *Farmers' Oversea Tours.*—A second tour was organized, on this occasion by the South African National Union. The previous tour took place in 1914 under the guidance of Dr. Wm. Macdonald. In each instance the selection of the farmers was left to the agricultural unions of the four Provinces. In 1914, 50 took part and on the last occasion 60. The organization of other tours as a regular institution has been mooted.

48. *British Empire Exhibition.*—The Exhibition, which is being continued this year for a further period of six months, was again fully supported by this Department.

49. *Legislation.*—During the 1925 Session of Parliament the following agricultural legislation was passed:—

(1) *The Agricultural Industries Advancement Act*, under which levies can be made on ostrich feathers, pigs, bacon, sugar-cane, sugar, and cheese, at the request of factories or co-operative societies, provided the funds are utilized for certain specified purposes.

(2) *The Orchard Cleansing Act*, which enables a majority in any area to ask that the cleansing of orchards of a specified insect pest or disease be made compulsory within that area, and that an inspector be appointed at the cost of orchardists to see that the provisions of the Act are carried out.

(3) *The Fruit Export Control Act*, which brings into existence a board to control the export of fruit.

(4) *The Diseases of Stock Further Amendment Act*, which gives additional powers to the Minister in connexion with the eradication of disease.

(5) *The Co-operative Societies Act Amendment Act*, which removes certain disabilities under the Act of 1922 that experience has shown to be desirable, and also applies the principle of compulsion where 75 per cent. of the producers of tobacco who are co-operators producing 75 per

cent. of the total yield in a particular area, desire the remainder of the producers to sell their product through a co-operative society. The principle can be extended to any other product by resolution of both Houses of Parliament.

(6) *The Wild Birds' Export Prohibition Act*, which places exportation in the discretion of the Minister of Agriculture.

(7) *The Public Auctions (Live Stock and Produce) Act*, which enjoins the furnishing by auctioneers to sellers of live stock and produce of certain information; requires agents and brokers to supply similar information to sellers of wool, mohair, hides, skins, sugar-cane produce, and ostrich feathers, and prohibits auctioneers from bidding for live stock or produce in which they are directly or indirectly interested.

50. *Stock Brands Bill.*—The Minister of Agriculture endeavoured to pass through Parliament a Stock Brands Bill. The first intention was to confine its provisions to large stock only. A demand for extension of the provisions to small stock as well led to the Bill being amended accordingly. It was clear, however, during the discussion which arose that the country is not ripe for a compulsory Small Stock Brands Bill, and it is very doubtful whether it will accept uniform legislation for the branding even of large stock on the lines of the three-piece system in force in the Trasvaal, which compels farmers to apply brands not of their own selection. The prevalence of stock thefts forms the subject of lengthy and vigorous discussion on nearly every agricultural union congress, when the severest penalties for stock thefts are demanded. It seems strange, therefore, that so much opposition is encountered to a measure which cannot fail to be of great assistance in the tracing of thefts. The explanation of this seeming anomaly is probably that those who are indifferent about or opposed to such legislation are not sufferers from theft.

51. *Levy Fund.*—The following is a statement as at the 30th June, 1925, of the receipts and expenditure, the rate levied, and the purpose to which the amount has been applied:—

Agricultural Products.	Accruals.	£ s. d.	£ s. d.	How Allocated.	£ s. d.	£ s. d.
Fruit. Rate: Citrus and Deciduous, 5s. per ton; Pines, 2s. per ton	Balance on 30th June, 1924	327 5 4		Contributions towards salary of Chief Fruit Inspector	100 0 0	
	Accruals 1st July, 1924, to 30th June, 1925	12,226 14 7		Contribution towards expenses of visit of Professor Webber	300 0 0	
			12,553 19 11	Portion of Expenses of Fruit Export Inquiry Committee	300 0 0	
				Payments to Fruitgrowers' Co-operative Exchange of South Africa, Ltd.	11,055 15 4	
						11,755 15 4
				Balance		798 4 7
			£12,553 19 11			£12,553 19 11
Eggs. Rate: 9d. per case	Balance on 30th June, 1924	1,990 4 5		Part payment of salaries and travelling expenses, Chief Poultry Officer and two Itinerant Instructors	605 6 7	
	Accruals 1st July, 1924, to 30th June, 1925	2,837 14 9				
			4,827 19 2	Poultry Week grants	10 0 0	
				Expenses of Standing Committee	152 6 11	
				Purchase of eggs from Egg Circles for experiments as to keeping qualities	6 13 2	
						774 6 8
				Balance		4,053 12 6
			£4,827 19 2			£4,827 19 2
Cotton. Rate: Cotton Lint, at 1s. per 100 lb.; Seed Cotton, at 1s. per 300 lb.	Balance on 30th June, 1924	874 14 4		Payments to Central Co-operative Cotton Exchange	1,500 0 0	
	Accruals 1st July, 1924, to 30th June, 1925	1,722 9 0		Contribution towards expenses of visit of Professor Webber	150 0 0	
			2,597 3 4			1,650 0 0
				Balance		947 3 4
			£2,597 3 4			£2,597 3 4

Commitments: *Levy Funds*.—The Commitments for the remaining six months of 1925 in respect of various levies are as under:—

	£ s. d.	£ s. d.
Fruit.		
Fruitgrowers' Co-operative Exchange: Citrus	4,000 0 0	
" " " Balance of Deciduous	1,257 11 8	
		5,257 11 8
Fruit Control Board		3,500 0 0
Contribution towards salary of Chief Fruit Inspector 1st July, 1925, to 31st December, 1925		50 0 0
Chief, Division of Economics and Markets for Fruit-eating Propaganda ...		500 0 0
Payment to crew of "Roman Star"		400 0 0
		£9,707 11 8
Eggs.		
Part payment of salaries and subsistence and travelling, Chief Poultry Officer and two Itinerant Instructors		1,000 0 0
Poultry Weeks grant		100 0 0
Expenses of Standing Committee		140 0 0
Printing report of A. O. John		60 0 0
Grant to Provinces for Promotion of Poultry Industry: 6 at £100 ...		600 0 0
Honorarium to Secretary S.A.P.A.		50 0 0
Scholarships (Oversea) at £200 per annum (probable)		400 0 0
		£2,350 0 0
Cotton.		
3 Scholarships at £200		600 0 0
Co-operative Manurial Experiments		500 0 0
Erection of Insectary		250 0 0
Central Co-operative Cotton Exchange		1,700 0 0
Salaries of two Entomologists		800 0 0
Travelling Expenses of two Entomologists		250 0 0
		£4,100 0 0

52. FOOD AND DRINK AND OTHER AGRICULTURAL PRODUCE.

Quantity and Value of Imports and Exports for the Year ended 30th June, 1925.

Article.		Imports.		Exports.	
		Quantity.	Value.	Quantity.	Value.
Food and Drink.			£		£
Ale, Beer, etc.	gal.	93,940	26,287	87,634	16,650
Butter and Substitutes ...	lb.	3,189,658	186,704	773,649	58,190
Cheese	lb.	361,197	21,400	332,406	17,559
Coffee	lb.	27,936,583	1,116,875	1,003,161	51,639
Confectionery and Jams...	lb.	4,435,135	325,269	2,071,540	75,503
Corn, Meal, Bran, etc.—					
Bran	lb.	1,869,103	5,538	3,685,269	3,820
Kaffir Corn ...	lb.	781,418	2,596	1,963,989	3,946
Maize	lb.	8,739,454	28,107	227,013,379	823,167
Maize Meal ...	lb.	3,284,756	14,335	151,427,383	538,785
Oats	lb.	148 789	980	18,316,047	55,494
Flour and Meal (wheaten)	lb.	68,423,009	494,528	9,423,731	88,483
Flour (ground from imported Wheat) ...	lb	—	—	2,877,707	29,151
Wheat	lb	313,021,568	1,653,079	495,731	5,887
All other kinds ...	lb.	43,620,283	305,540	10,178,047	56,110
Eggs, Fresh	No.	273,685	11,586	28,240,650	165,535
Eggs, Liquid or Crystallized	lb.	121,712	6,394	2,930	67
Fish—					
Dried and Cured ...	lb.	6,171,388	94,098	3,208,404	60,058
Fresh and Frozen ...	lb.	2,920	107	1,795,042	43,523
Crayfish, Preserved ...	lb.	—	—	4,525,852	264,232
Other Preserved ...	lb.	7,863,503	323,631	140,380	8,097
Fruit, Dried and Preserved	lb.	5,197,256	83,814	10,650,777	196,265
Fruit, Fresh—					
Citrus. ...	...boxes	44,482	31,943	2,103,770	620,844
Deciduous ...	...boxes				
Grapes ...	...boxes				
All other ...	...boxes				
Lard	lb.	597,954	22,838	56,384	2,325
Meats—					
Fresh and Frozen ...	lb	34,518	1,676	14,769,849	172,165
Preserved and Cured	lb.	3,646,162	172,871	300,197	16,983
Milk—					
Fresh	gal.	14,233	3,973	545	269
Condensed	lb.	9,585,424	285,551	357,116	12,626
Spirits	gal.	366,926	463,974	93,271	50,632
Sugar	lb	1,614,512	20,217	28,067,839	294,654
Sugar Products	lb	9,827,858	127,889	47,322,869	36,262
Tea	lb.	9,534,976	797,878	347,256	30,901
Vegetables, Tinned, etc....	lb.	1,060,082	28,867	22,609	496
Vegetables, Fresh—					
Potatoes	lb.	3,166,160	17,786	5,762,330	22,277
All other	lb.	6,146	914	—	21,552
Wines	gal.	45,218	43,728	348 859	57,791
All other articles of Food and Drink	...	—	1,395,381*	—	86,268
TOTAL		—	£8,116,354†	—	£3,988,206‡

* Of this amount, £274,872 represents rice.
† Includes £175,730 South African produce.
‡ South African produce, £3,795,089. Imported goods re-exported, £193,117.

Article.		Imports.		Exports.	
		Quantity.	Value.	Quantity.	Value.
Other Agricultural Produce.			£		£
Animals, all kinds ...		—	561,250	—	94,729
Fodder and Forage ...	lb.	2,231,356	22,133	31,406,073	112,532
Hides and Skins	lb.	3,564,723	118,638	74,683,377	3,085,714
Tobacco, all kinds ...	lb.	5,648,414	396,910	1,058,145	216,714
Wattle Bark and Extracts	lb.	—	—	265,051,622	1,042,172
Cotton, raw	lb.	—	1,091	4,273,404	224,857
Ostrich Feathers	lb.	17	4	344.003	316,620
Hair, Angora	lb.	6,410	213	11,610,738	937,703
Horns, Ox and Cow ...	lb.	1,878	16	979,[illegible]30	24,562
Wool, all kinds	lb.	246,427	13,188	162,403,483	14,616,434
TOTAL		—	£1,113,443*	—	£20,672,037†
GRAND TOTAL, Food and Drink and other Agricultural Produce		—	£9,229,797‡	—	£24,660,243§

* South African produce, £955,502. Other imports, £157,941.

† South African produce. £20,665,479. Imported goods re-exported, £6,558.

‡ South African produce, £1,131,232. Other imports, £8,098,565.

§ South African produce. £24,460,568. Imported goods re-exported, £199,675.

53. PRODUCTION OF PRINCIPAL CROPS

(as per Census Returns).

Crop.		Year ended 30th April, 1922.	Year ended 31st August, 1923.	Year ended 31st August, 1924.
Barley (grain)	lb.	63 054,000	58,235,000*	50,154,450
Barley (forage)	lb.	21,819,000	25,620,000*	22,598,695
Cotton (not ginned)... ...	lb.	2,806,000	7,346,000*	10,003,285
Ground-nuts	lb.	7,501,000	11,785,000	14,378,070
Kaffir Corn	lb.	124,560,000	415,985,000	246,032,200
Maize	lb.	2,527,249,000	3,967,979,000	2,247,768,400
Manna (grain)	lb.	1,602,000	2,717,000*	3,586,200
Manna (forage)	lb.	62,941,000	58,639,000*	42,210,392
Oats (grain)	lb.	165,959,000	183,285,000*	211,069,350
Oats (forage)...	lb.	369,131,000	380,289,000*	268,336,194
Potatoes	lb.	259,855,000	211,085,000*	211 770,600
Rye	lb.	37,895,000	44,804,000*	37,825,200
Sugar	lb.	293,974,000	318,724,000	3,837,120,000
Sunflower Seed	lb.	2,495,000	Not enumerated	Not enumerated
Tobacco	lb.	9,813,000	9,671,000	11,406,362
Wheat...	lb.	522,531,000	376,270,000	358,392,200

* Exclusive of native locations.

REPORT No. I.—VETERINARY DIVISION.

Principal Veterinary Officer: J. D. BORTHWICK, M.R.C.V.S.

1. *General.*—The position of stock diseases generally throughout the Union continues satisfactory. In Natal, the East Coast fever position showed considerable improvement, and satisfactory progress continued in the Transkei and Transvaal.

In August, 1924, a committee was formed, consisting of Mr. G Bridson, as Chairman, and Messrs. A. Spies, Dr. du Toit, and J. D. Borthwick, with Mr. P. te Groen as Secretary, to inquire into and report upon the East Coast fever position in Natal; as a result of its report arrangements were made whereby the Veterinary Division assumed full control (which in the past had been vested in the Native Affairs Department) of the dipping staff in native areas. Although the new control had not become fully effective, much good is expected to result in the near future from this important change. Space does not permit of the full report of the committee being printed here, but mention may be made of two important conclusions arrived at, namely, (*a*) that while the committee was satisfied from the evidence before it that the regulations inflict hardships on owners of stock—not only on infected but on contact and clean farms—the majority of stock owners realize that little, if any, relaxation of present restrictions could be granted without danger; and (*b*) that evidence led has proved that numerous farmers consider the dipping of their cattle as a purely domestic affair, but the committee was of opinion that in any campaign having for its object the final eradication of East Coast fever, the dipping of every beast must be looked upon as a national matter and controlled accordingly.

The staff in Natal was further increased and the East Coast fever position improved correspondingly. During the year ended 30th June, 1923, when 140 fresh outbreaks occurred, 64 dipping inspectors were employed. In 1923-24 there were 120 fresh outbreaks, and 147 inspectors employed, while for 1924-25 the figures were 60 fresh outbreaks and 156 inspectors. If proof were needed that strict supervision is necessary if East Coast fever is to be eradicated, these figures furnish it conclusively. The ideal position would be a competent staff, sufficiently strong in numbers to supervise clean as well as infected farms. If this were possible, there is little doubt the disease could be completely eradicated in a very short time.

During the year the work of the Sheep Division was amalgamated with that of the Veterinary Division, and entailed a considerable amount of reorganization of staff and duties. Indeed, it will be some time before the new organization can be expected to show definite results, but it is hoped that the new scheme, under one control, will shortly be working smoothly and satisfactorily. Another innovation of importance was effected during the year in the control of veterinary field work in the Cape Province. For some considerable time past it

had been realized that, owing to the extensive area of the Cape, the work could not be controlled as efficiently by the Senior Veterinary Officer at Cape Town as was desirable. Two alternatives presented themselves, viz., to transfer the headquarters of the Senior Veterinary Officer from Cape Town to some more central point in the Province, or to divide the Province into two sections and appoint another Senior Veterinary Officer in the eastern section. The latter course was decided upon, and in December, 1924, Mr. A. Goodall, Senior Veterinary Officer, Windhoek, was transferred from Windhoek to Queenstown to take charge of the eastern section, the Senior Veterinary Officer, Cape Town, retaining control of the western portion. Mr. R. S. Garraway, District Veterinary Officer for the Pretoria District, was transferred to Windhoek to replace Mr. Goodall. The reports of the two seniors in charge of the western and eastern portions of the Cape have been merged in this report, but separate reports will be published in future. The authorized staff was increased during the year by one senior and three district veterinary officers.

2. *East Coast Fever*: *Transkei*.—The excellent progress made during the past two years continued, in spite of the fact that dipping and hand-dressing operations were considerably handicapped owing to the abnormal rains experienced during the summer months—the most critical time of the year, when tick life is most active. Only five fresh outbreaks occurred, three of which were isolated cases due to illicit movements of cattle or to an extension of disease from adjoining infected areas. Four districts became clean, and twenty-two farms and locations still remained in quarantine, although a number of these had completed fifteen months since the last death. With the exception of Willowvale, all districts between the Kei and Umzimvubu Rivers were free from disease, and the whole of the Cape border is clean. Willowvale District, which was the cause of considerable anxiety last year, made marked progress, the disease being confined to two tank areas, which it is hoped will become clean before the end of June, 1926. The latter remark also applied to the Umzimkulu District, where ten areas were released from quarantine during the year. Of the eight remaining it is hoped two will become clean at an early date. No fresh outbreaks occurred in the Umzimkulu District during the year, which constitutes a record. Two fresh outbreaks of a serious nature were diagnosed in the Mount Ayliff District. The first in Mbongweni area in November, and the second in Lukuni area in December, 1924. Unfortunately these two centres of infection had been smouldering for nearly twelve months before discovery, as the result of neglect of duty on the part of two temporary field officers, who were promptly dismissed. It was feared at first that an extension of the disease might have taken place, but, fortunately, it transpired that this was not so, and as the result of thorough reorganization and close supervision the outbreaks were got under complete control, and it is confidently hoped will be speedily stamped out.

Cape and Orange Free State.—No outbreaks of East Coast fever were reported in either of these Provinces; the disease is therefore non-existent.

Transvaal.—Infection exists in five districts as compared with seven last year. During the year the Wakkerstroom, Carolina, and Zoutpansberg Districts became clean, whilst reinfection occurred in the Barberton and Pilgrims Rest Districts. Twenty-seven farms

became clean, and 198—which figure includes a number of contact farms—were released from quarantine. Eleven fresh outbreaks occurred in the following districts:—Pietersburg 9, Barberton 1, Pilgrims Rest 1; the number of infected farms being—Pietersburg 11, Barberton 1, Pilgrims Rest 1, Ermelo 1, Piet Retief 3. Satisfactory progress was made in the Piet Retief District, where no deaths occurred for thirteen months. In the Pilgrims Rest District an outbreak occurred on the farm Waterval, which resulted in only one death nine months ago; it is therefore safe to conclude that the disease will cause no further trouble there. In the Barberton District a reinfection occurred in August, 1924, on the farm Joubertsdal No. 99, a second death occurring the following month; only a portion of the farm was infected and the cattle running thereon were slaughtered by the owner, who thereby prevented the spread of infection. As the result of the slaughter of the cattle on the farm Johnstonsrust, in the Pietersburg District, the spread of infection was also arrested there, and the position improved sufficiently to justify the opening of a portion of the district for cattle to the open market. The position on the infected farm Rietvlei No. 791, Groot Spelonken area, is unsatisfactory. The disease obtained a hold on the farm as the result of the scarcity of grazing due to the heavy locust infestation. The poverty-stricken condition of the cattle necessitated the extension of the dipping interval, and, in the case of some of the animals, the complete cessation of dipping. Two other farms consequently became involved in this outbreak. Two further outbreaks occurred in the Pietersburg District—one on the farm Kroomdraai, in the tank on which farm the cattle from nine other farms were dipping at the time and consequently became involved in the outbreak; six of these farms were considered infected. The other outbreak occurred on the farm De Hoek, a Government Forestry Station, where the cattle have since been slaughtered. This should prevent any further spread of disease in this area. In the Ermelo District only one farm remained infected, on which the last death occurred thirteen months ago.

Natal.—During the year sixty fresh outbreaks occurred, as against 120 last year. On the 30th June, 1925, there were 157 farms in quarantine, as compared with 257 on the 30th June, 1924. This year 160 farms became clean as against 121 during the previous year. In connexion with the sixty fresh outbreaks this year, the percentage of deaths was 1.9. The fact that the infected areas are so widely distributed throughout the whole of the Province proved one of the chief difficulties in combating the disease successfully with a limited field staff. The abolition of the dual control by the Sheep and Veterinary Divisions and, in the native areas, by the Native Affairs Department and the Veterinary Division, are innovations which were welcomed by stock owners in general. Dipping operations were seriously interfered with by the abnormally heavy rains at a time when tick life was most active. The compulsory dipping of sheep also interfered with the systematic work in connexion with East Coast fever, as the staff outside areas actually infected had to be called upon to assist in sheep dipping for several months. In the Newcastle District no fresh outbreaks occurred, and on the one infected farm, Doornkop, no deaths occurred for over three months. The Utrecht District is now clean, while on the 30th June, 1924, there were three infected farms. The Dundee District is now considered clean, with

the exception of the infection in the Washbank Valley, where only five deaths occurred on three contact farms. In the Helpmakaar District excellent progress was made and no fresh outbreaks occurred. In Nqutu (Zululand) there were four areas in quarantine on the 30th June, 1924, but the district is now clean. Eight outbreaks occurred in the Vryheid District, in four of which the first case of the disease was discovered, indicating that the supervision was good. Unfortunately, little progress was made in this district. The conditions are difficult; a large number of the farms, occupied only by natives, are situated in out of the way parts, and on many farms occupied by Europeans, natives own most of the cattle. Extra staff was provided and the supervision improved; greater progress is therefore anticipated in the future. Two fresh outbreaks occurred in the Paulpietersburg District, while nine infected areas became clean. In the Ngotshe District satisfactory progress was made; no fresh outbreaks occurred, and no case of the disease has occurred for over twelve months. The Babanango District became clean during the year, but one case, contracted in Zululand, was introduced. No further cases occurred, however, and special precautions are being taken. In the Ladysmith District four fresh outbreaks occurred, resulting in fourteen deaths. No fresh outbreaks occurred in the Bergville District; only one farm remained in quarantine, which will shortly become clean by lapse of time. Three fresh outbreaks occurred in the Estcourt District: the most serious, on the farm Rietfontein, was apparently confined to a fenced paddock, from which all cattle were removed, and no case occurred outside. The only infected area remaining in the Weenen District is at Muden. The position in the Umvoti District improved, and, although there were nine infected areas remaining, no appreciable mortality occurred except on two, viz., the farm Onrust and the native location. Progress was made in the New Hanover District, the number of infected farms being reduced from nine to six, two of which were almost due for release from quarantine and two were unlikely to cause any further trouble. The position in Mpofana, entirely a native area, cannot be considered satisfactory and is receiving special attention. Seven outbreaks occurred in the Pietermaritzburg District owing to its being understaffed, and steps were taken to provide more supervision. The Camperdown District, where last year there were seven infected areas, became clean during the year. In the Lions River District four farms were in quarantine, on which two deaths occurred, but further deaths were not anticipated. In Impendhle only one farm remained in quarantine. Marked progress was made in the Richmond District; on the 30th June, 1924, there were twenty-four infected farms, now reduced to eleven, four of which will shortly become clean through lapse of time. The Ixopo District a few years ago was one of the worst infected districts. Last year there were twenty-nine infected areas, reduced this year to fifteen, six of which will shortly become clean through lapse of time. Only one of the infected areas remaining is likely to cause any trouble. In the Polela District there were three areas in quarantine, only one of which was regarded as serious. Much progress was made in the Mapumulo District, an entirely native area, and the position here was satisfactory. Satisfactory progress was also made in the Lower Tugela District, where thirteen farms were released from quarantine during the year. In the Ndwedwe District, which is also wholly

occupied by natives, satisfactory progress was made; only one infected area remained, wherein the last death occurred in June, 1924. Considerable progress was made in the Pinetown District; no fresh outbreaks occurred, and with the exception of Pinetown Village the whole of the district can now be regarded as clean. In the village isolated cases occurred at long intervals, though there was no doubt dipping was efficiently carried out. The eradication of the disease in the coastal belt, comprising the districts of Durban, Inanda, Mapumulo, Lower Tugela, Ndwedwe, and Pinetown, proved a most difficult matter, and it is therefore gratifying to be able to record such substantial progress. It is hoped that in a comparatively short time the whole of this coastal belt will be practically clean. In Port Shepstone, also a coastal district, very satisfactory progress was made. No fresh outbreaks occurred, and of the twenty infected areas existing on the 30th June, 1924, eleven were released from quarantine, and it is considered the disease is well under control on those areas remaining in quarantine. No fresh outbreaks occurred in the Harding District, and all infected areas were released from quarantine with the exception of the farm Staffordspost, where a death occurred in April, 1925, after an interval of ten months. The following districts are now clean:—Krantzkop, Durban, Inanda, and Umzinto. In Eshowe District (Zululand) six fresh outbreaks occurred. In three of these outbreaks only one death each occurred, all in calves under 6 months old. Unfortunately the other three outbreaks occurred on properties along the main transport road and caused considerable inconvenience to the public. The position here cannot be regarded as other than unsatisfactory, and steps were taken to ensure strict supervision throughout the whole area. Several visits were made by the Senior Veterinary Officer for Natal in person, who considered the staff in the native reserves should be strengthened. Four fresh outbreaks also occurred in Emtonjaneni (Zululand), the source of two of which was traced to the Eshowe District, and serious inconvenience was caused to the public owing to the infection of the Melmoth town lands. So far as is known, the district of Mtunzini (Zululand) is practically free from infection, although the disease was diagnosed in an area remote from any known place of infection. The Lower Umfolosi District (Zululand) had been free from disease for several years until recently, when two fresh outbreaks occurred, probably introduced from Eshowe or Emtonjaneni. The position here was unsatisfactory, but the staff was increased, and it is hoped this will have the desired effect. The position improved in Nkandhla (Zululand), and with strict supervision there seems no reason why this district should not become practically clean in a comparatively short time. Special attention was paid to all districts in southern Zululand. The following districts, comprising the veterinary area of northern Zululand, were all clean, viz., Ingwavuma, Ubombo, and Mahlabatini. Infection existed in the Nongoma District, but satisfactory progress was made. In the native reserves of the Hlabisa District the position was unsatisfactory, and it is considered that some trouble will be experienced before the disease is eradicated, as it is difficult to obtain suitable staff willing to serve in the unhealthy parts of Zululand.

3. *Anthrax*: *Orange Free State.*—The number of outbreaks was 195, as compared with 263 during the previous year. Of the 195, twelve were recurrent, leaving a balance of 183 fresh outbreaks. The

largest number of deaths occurred in the following districts, which are given in the order of severity:—Kroonstad, Winburg, Heilbron, Bethlehem, Thaba 'Nchu, and Lindley. The general position, however, is satisfactory, as a decrease is shown both in the number of outbreaks and in the number of deaths. The use of spore vaccine continued to give satisfactory results, and during the year 275,125 doses of vaccine were issued, of which 36,682 were for the inoculation of animals concerned in actual outbreaks, while 238,443 doses were used for preventive inoculation. The deaths in the outbreaks referred to above totalled 499, out of a total number of 36,682 animals inoculated, as compared with 1,339 deaths among 76,252 animals inoculated the previous year. The number of transport animals inoculated was 1,936.

Transkei.—Systematic inoculation continued as in previous years, but as the majority of the field officers had been called upon to perform extra duties in connexion with scab eradication it was impossible to carry out inoculations quite as promptly as hitherto. During the year 295,373 animals were inoculated, as compared with 461,900 the previous year. The number of outbreaks totalled 429 as against 484 last year.

Cape.—Infected herds and flocks were re-inoculated, also a large number of transport animals, both equine and bovine. In areas where compulsory inoculation had been in force good results therefrom are already apparent. The outbreaks occurred chiefly in Griqualand West, and of the few outbreaks outside that area only one, in Piquetberg, was serious. The position in the eastern portion of the Cape Province showed considerable improvement, attributable to regular inoculation as a preventive measure. Particularly satisfactory progress was shown in the Districts of Glen Grey and Komgha. The total number of outbreaks reported was 124, compared with 316 the previous year. The number of deaths totalled 471, against 2,377, and the number of animals inoculated 315,276, compared with 339,295 last year.

Transvaal.—The number of outbreaks reported was 399 as against 579 last year, showing a decrease of 180. The number of animals inoculated was 155,194, as compared with 257,138 last year, while the deaths totalled 811 as against 1,129 the previous year. The whole of the stock in the Taungs native area was inoculated as a preventive measure, which will no doubt have a good effect.

Natal.—Ninety outbreaks occurred as compared with 114 the previous year. The number of "in-contacts" dealt with was 41,786, and 257 deaths occurred in connexion with the ninety outbreaks. Last year 312 deaths occurred amongst the 56,724 animals concerned in the 114 outbreaks. During the year the following animals were inoculated as a preventive measure:—123,697 cattle, 100 equines, 110 sheep, and 6 pigs.

4. *Tuberculosis*: *Orange Free State.*—During the period under review 131 head of cattle were subjected to the tuberculin test, to which two animals reacted. The total number of outbreaks reported was two, as compared with five the previous year. Twenty-five cases of tuberculosis in pigs were reported by the Johannesburg and Bloemfontein abattoirs, but attempts to trace "in-contacts" were unsuccessful.

Transkei.—Only one isolated case was discovered at Tsolo. The animal, a cow, was promptly destroyed; there were no contacts. Last year no outbreaks were recorded.

Cape.—During the year 728 head of cattle were tested for tuberculosis; 14 animals reacted and were destroyed, as compared with 880 animals and 18 reactors destroyed last year. Only one outbreak was recorded; the tuberculin test was applied to all animals concerned; three reacted and were destroyed. A number of animals exported from the Union were also subjected to the test in compliance with the regulations of the countries of destination. Two cases were reported from the Port Elizabeth abattoirs in cattle from a farm in the Uitenhage District. Four reactors were destroyed in the Middelburg District, Cape Province. The disease was prevalent to some considerable extent in swine.

Transvaal.—Four outbreaks occurred, one each in the Districts of Rustenburg, Witwatersrand, Potchefstroom, and Pretoria, involving 640 animals, which were subjected to the tuberculin test; 109 reacted and were slaughtered. In addition, one animal was condemned and slaughtered without applying the test. A number of cattle, including some pedigree animals, were tested prior to their removal to destinations outside the Transvaal. From the returns of the Municipal Abattoirs of Johannesburg, Pretoria, Germiston, Brakpan, Benoni, Krugersdorp, and Randfontein collectively, the percentage of infected cattle was 0.109 and of swine 0.602.

Natal.—Five outbreaks occurred and 167 head of cattle were tested, 29 of which reacted, as compared with 2 outbreaks, 74 animals tested, and 7 reactors last year.

5. *Dourine*: *Orange Free State.*—No outbreaks occurred, and the position therefore remained unchanged. A keen observation was maintained, and the disease evidently is non-existent.

Transkei.—No outbreaks recorded.

Cape.—The position is considered satisfactory. At the beginning of the year there were twenty-five farms in quarantine, seventeen of which have since been released. Three new outbreaks were recorded, involving 167 animals and necessitating the destruction of twenty-seven mares. At the end of the year there were eleven farms remaining in quarantine.

Transvaal.—Eleven outbreaks occurred as compared with 18 last year; 11 animals were destroyed as against 21 the previous year, and one death occurred. Two of the outbreaks occurred in the Schweizer Reneke District and nine in British Bechuanaland, made up as follows:—7 in Kuruman, where 18 farms were in quarantine, Vryburg 1, Mafeking 1.

Natal.—No outbreaks recorded.

6. *Glanders*: *Orange Free State.*—No outbreaks occurred. Twenty-six animals were subjected to the Mallein test and none reacted. No outbreaks occurred last year.

Transkei.—No outbreaks recorded as against one last year.

Cape.—The position continued unsatisfactory. A large number of outbreaks occurred, but fortunately were not widely distributed,

the majority being confined to Cape Town and its suburbs. All reacting animals were promptly destroyed and the infected stables and other premises immediately disinfected. The officials of the Cape Town Municipality rendered assistance in connexion with the disinfection of stables, and as the result of their co-operation many unsatisfactory premises have been reconditioned. Great difficulty is usually encountered in tracing the source of infection, particularly in cases where the animals concerned are owned by coloured people. The reporting of suspects is very lax, most of the outbreaks—other than those discovered by the Government veterinary officers—being reported by the S.P.C.A. or the police. A general round-up of all equines was held in Claremont and Newlands, and as a result 375 animals were tested and three reacted. Two outbreaks occurred in the Uitenhage District. The number of outbreaks was 47, compared with 42 the previous year, involving 945 animals, 156 of which died, as compared with 747 animals and 127 deaths the previous year.

Transvaal.—Four outbreaks were recorded as against one last year—two on the Witwatersrand and two in Pretoria. These outbreaks involved the testing of 466 equines and the destruction of 26.

Natal.—No outbreaks recorded.

7. *Mange*: *Orange Free State.*—Twenty outbreaks occurred as compared with seventeen the previous year. The districts affected were:—Vrede, Senekal, Heilbron, Frankfort, and Lindley.

Transkei.—Seventy cases were reported, compared with thirty-five the previous year, all of which were treated successfully.

Cape.—The disease was not prevalent in the Cape western area. Outbreaks occurred in six districts only, chiefly amongst animals owned by coloured persons in Cape Town and its suburbs. The disease was more evident in the eastern portion of the Cape than in the past, but the increase may be due to the increased activity of the police and veterinary officers. The number of outbreaks totalled 235, involving 1,180 animals, compared with 208 outbreaks, involving 771 animals the previous year.

Transvaal.—The number of outbreaks recorded was 126, as against 87 last year, involving the death or destruction of 15 animals, as compared with 27 the previous year, and 243 animals were treated as against 158 last year. The outbreaks occurred in the following districts:—Witwatersrand 52, Wakkerstroom 42, Heidelberg 18, Standerton 9, Pretoria 2, Rustenburg 2, Bethal 1.

Natal.—The disease was prevalent to some extent, chiefly in native locations, where it was found difficult to adopt suitable treatment. Sixteen outbreaks were recorded, involving the treatment of 173 animals. Last year no outbreaks were recorded.

8. *Other Proclaimed Diseases*: (a) *Epizootic Lymphangitis.*—For the first time for many years no outbreaks were recorded in the Cape western area, while in the eastern area only one case was reported, from the Bathurst District.

(b) *Swine Fever.*—No outbreaks recorded.

9. *Non-proclaimed Diseases*: (a) *Horse-sickness.*—This disease was prevalent in the Orange Free State during the summer months,

but, in spite of the abnormally wet season, deaths were not so numerous as might have been expected. Ninety-seven mules were inoculated. In the Transkei the disease was rife in the Umzimkulu District, especially along the Ibisi River and in Baka's Location, where a large number of deaths occurred. Outside the Umzimkulu District very few deaths took place. In the Cape the disease was prevalent as a result of heavy rains, and exceptionally heavy losses were sustained in Griqualand West. Although a few deaths occurred there two years ago, it is about thirty years since this disease was last known in the Robertson District and the south-west. This year in the Piquetberg District, especially in the Porterville area, heavy losses were sustained, and several deaths occurred in the Robertson, Montagu, and Ladismith Districts. In the Transvaal 2,519 mules were inoculated, the number of deaths resulting being 18.

(b) *Blue-tongue* was prevalent in the Orange Free State during the summer months. In the Cape the disease was prevalent in some districts in the western area, and it was found that the farmers were not too ready to protect their flocks by means of inoculation. In the eastern area of the Cape, in spite of the exceptionally heavy rainfall, the disease, contrary to expectations, was not so prevalent this year. Preventive inoculation has been applied on a large scale in the Border districts with apparently highly satisfactory results both as regards immunity conferred by, and losses sustained from, the after-effects of inoculation.

(c) *Contagious Vaginitis.*—A few cases were recorded in the Orange Free State and were treated under the direction of field officers of the Veterinary Division. In the Cape the disease was prevalent.

(d) *Contagious Abortion.*—Three outbreaks were reported in the Orange Free State, and the agglutination test was applied to 73 animals, resulting in 6 being found positive and 67 negative. Very little was heard of the disease in the Cape.

(e) *Redwater* has been less prevalent in the George and Knysna Districts of the Cape since the dipping of cattle was taken in hand.

(f) *Anaplasmosis* was the cause of mortality amongst calves and young stock in the Somerset West and Saldanha Bay areas of the Cape. Ticks are becoming increasingly prevalent, and it will be necessary for dipping-tanks to be constructed and brought into commission if losses of stock are to be minimized. In the eastern portion of the Cape Province a recrudescence of the disease was experienced, particularly in the Karroo.

(g) *Lamziekte.*—This disease was less prevalent in the western area of the Cape than in the past. In the eastern area large losses were sustained in the Grahamstown District, yet farmers as a whole took little trouble in the way of preventive measures.

(h) *Wireworm and Nodular Worms.*—The long-continued summer rains resulted in luxuriant growth of grass in Griqualand West, causing heavy worm infestations and great loss of condition in the flocks.

(i) *Trichostrongylus Worm* was detected in some wireworm-infested sheep at Glen Ross on the brow of the Kaap Plateau in the Cape.

(j) *Vermeerziekte* was extremely prevalent in the Cape. In some parts the heavy rains washed out the causative bush to some extent. Goats, cattle, and even donkeys died of the disease.

(k) *Waterpens*, a peculiar form of dropsy with peritonitis and cirrhotic liver, was met with in the Uniondale District of the Cape, where it caused considerable loss amongst sheep and goats, and even amongst lambs and kids.

(l) *Geeldikkop* trouble was met with in the Bushmanland portion of the Calvinia District of the Cape.

(m) *Quarter Evil* occurred in two flocks of sheep in the Middelburg District, Cape Province, but the disease was not generally prevalent in the Cape Province.

(n) *Internal Parasites* caused the death of many sheep in the eastern portion of the Cape Province. Much might be done to combat this trouble by providing stock with clean drinking water, instead of allowing animals to water at stagnant dams as is generally the custom. The wireworm remedy issued by the Government Veterinary Research Laboratory was used with success, and is becoming increasingly popular amongst stockowners.

10. *Statistics*:—

(a) *Animals Imported into the Union from Overseas, Year ended 30th June*, 1925.

Port of Entry.	Cattle.	Horses.	Sheep.	Pigs.	Dogs.	Cats.	Zoological Specimens and Miscellaneous.	Total.
Cape Town	38	50	262	11	104	9	9	483
Port Elizabeth ...	5	—	—	—	4	—	—	9
East London ...	1	—	1	—	—	—	—	2
Durban	23	11	1,062	49	31	—	14	1,190
TOTAL ...	67	61	1,325	60	139	9	23	1,684

(b) *Statement showing Breed and Sex of certain of above.*

CATTLE.			SHEEP.		
Breed.	Males.	Females.	Breed.	Rams.	Ewes.
Fries'ands... ...	8	5	Merinos	340	910
Swiss	3	10	Corriedale... ...	2	29
Jerseys	2	6	Rambouillet ...	3	—
Shorthorn.. ...	6	9	Suffolk	3	36
Hereford	1	—	Dorset Horn ...	1	—
Ayrshires	6	10	Cappeedee ...	1	—
Galloway	1	—			
TOTAL ...	27	40	TOTAL ...	350	975

PIGS.			HORSES.		
Breed.	Males.	Females.	Stallions and Colts.	Mares and Fillies.	Geldings.
Large Black	2	9			
Other Varieties ...	29	20	19	27	15
TOTAL	31	29			

(c) *Cattle Imported into the Union from Adjoining Territories.*

From.	For Slaughter.		For Restocking.	
	1923–24.	1924–25.	1923 24.	1924–25.
Southern Rhodesia	41,716	19,250	—	—
Bechuanaland Protectorate	47,143	35,626	...	
South-West Africa	47,047	27,209	3,024	908
Swaziland	5,465	9,814	—	—
Basutoland	—	—	—	
TOTAL	141,371	91,899	3,024	908

(d) *Cattle-dipping Tanks as at 30th June*, 1924, *and* 1925.

Province.	1924.	1925.
Cape (exclusive of Transkeian Territories)...	2,127	2,129
Orange Free State	366	403
Transvaal	3,103	3,117
Natal	6,024	6,209
Transkei	888	904

Applications to the Land Bank for advances for the construction of dipping-tanks totalled 133, compared with 185 for the preceding twelve months.

(e) *Export of Meat.*—During the year, 36,905 head of cattle, compared with 16,396 during the previous year, were inspected for export, and the following are the quantities of beef exported:—1923-24, 34,891 quarters; 1924-25, 118,001 quarters. During the year 1924-25, 3,000 lb. of bacon were exported, compared with 54,382 lb. last year.

The quantity of beef exported under the Beef Bounties Act, No. 12 of 1923, was 9,580,306 lb.; the bounty paid at ½d. per lb. amounted to £19,958. 19s. 5d.

(f) *Legal Proceedings Instituted by the Division, Year ended 30th June*, 1925.

Province.	Prosecutions.	Fines.
	No.	£
Cape	292	723
Transvaal	89	185
Natal	2,883	4,374
Orange Free State	42	94
Transkeian Territories	1,149	1,646
TOTAL	4,455	7,022

SHEEP SECTION.

1. *Organization.*—The Sheep Division was abolished as from the 1st October, 1924, and the scab eradication work taken over by the Veterinary Division. Owing to this amalgamation, it was found possible to dispense with the services of a number of officers and a considerable annual saving, amounting to approximately £39,700, in salaries and travelling expenses was thus effected. Notwithstanding the reduction of staff in the Sheep Section owing to the employment of the veterinary staff on scab work, it has been possible in those areas where scab is still prevalent to reduce inspectors' areas and a closer supervision is being exercised.

2. *Scab*: (*a*) *Present Position.*—The percentage of scab-infected flocks inclusive of contact flocks, i.e. flocks quarantined but not actually infected for the twelve months ended 30th June, 1925, was 3.65 per cent. for the whole Union. The flocks actually infected amounted to 2.27 per cent. for the year. This shows a slight increase on the figures of last year. It is accounted for by the fact that when the veterinary officers took over the scab work, a number of cases of hidden scab were discovered, mostly in the native territories. For instance, in the Transkei at the end of October, 1924, prior to the completion of the reorganization, 175 flocks were in quarantine, whereas at the end of January the total reached 2,053. At the end of June, 1,215 flocks were in quarantine in the Transkei. In the Cape Province, Transvaal, Natal, and Orange Free State a considerable reduction is shown and the progress is very gratifying.

(*b*) *Compulsory Dipping.*—The Minister decided upon a compulsory dipping campaign in an effort to eradicate scab or at least reduce it to a minimum. It was decided to dip all sheep in those districts which had had scab within six months from the order of dipping. The order applied to the whole of the Transvaal, Natal (excepting three districts which were exempted from the compulsory dipping), and two districts of the Orange Free State where scab

was prevalent. Unfortunately, weather conditions were very unfavourable for the dipping. As the Department did not have the staff available for the necessary supervision, volunteers were asked for and the response was very gratifying. The appointments of such honorary inspectors were made on the recommendation of magistrates and farmers' associations: 7,285,299 sheep were dipped by area inspectors and 913,437 by itinerant inspectors. This included the dipping of infected flocks, and as a precautionary measure under protected area regulations. At the time of writing a vigorous dipping campaign is being carried out in the north-western districts of the Cape Province.

(c) *Protection.*—During the year protection was extended to seven districts:—Cape, protected 4; Transvaal, protected 1; Free State, protected 1; Natal, semi-protected 1; which made the total in the Union as follows:—Protected: Cape, 56; Orange Free State, 22; Transvaal, 8. Semi-protected: Cape, 25; Orange Free State, nil; Transvaal, 1; Natal, 7.

The following districts are fully protected:—*

Cape Province: Malmesbury, Robertson, Uniondale, Victoria East, Komgha, East London, eastern portion of King Williams Town, Tulbagh, Oudtshoorn, Piquetberg, western portion of Beaufort West, Stutterheim, Stellenbosch, Taungs, Steynsburg, Maraisburg, Molteno, Venterstad, Albert, Middelburg, Colesberg, De Aar, Philipstown, Hopetown, Britstown, the western portion of Wodehouse District, George, Mossel Bay, Hanover, Richmond, Graaff-Reinet, Knysna, Humansdorp, Uitenhage, Port Elizabeth, Alexandria, Albany, Bedford, Bathurst, Peddie, Murraysburg, Victoria West, Carnarvon, Cathcart, Stockenstrom, Queenstown, Tarkastad, Fort Beaufort (Adelaide), Cradock, Somerset East, Riversdale, Ladismith, Ceres, Worcester, Swellendam, Prieska, Somerset East, Laingsburg, Prince Albert, Pearston, Glen Grey, Bredasdorp; ward Lower River Zonder End, Caledon District, exclusive of the farms Zoetmelkvlei, Oudekraal, Ganskraal, Bot River, Annex Bot River, and Bloemkraal.

Orange Free State: The whole Province except Vrede and Harrismith.

Transvaal: Barberton, Carolina, Lydenburg, Wolmaransstad, Lichtenburg (exclusive of Kunana Location), Potchefstroom, Ventersdorp, Klerksdorp.

The following districts are semi-protected:—

Cape Province: The districts of Aberdeen, Jansenville, Steytlerville, Willowmore, Fraserburg, Elliot, Maclear, Barkly East. Aliwal North, including Lady Grey, Paarl, Caledon, excluding the portion mentioned as fully protected; the northern portion of Cape, Wodehouse, excluding the portions mentioned as fully protected; Clanwilliam, Montagu, Matatiele, Mount Currie, Umzimkulu, the eastern portion of Kenhardt, Hay, Herbert, Kimberley, Barkly West, Kuruman, Vryburg, the south-western portion of Mafeking, and the western half of King Williams Town.

Transvaal: Ward Klipriver, Heidelberg; Bloemhof.

* Protected and semi-protected areas shown as at 1st October, 1925.

Natal: Alfred, Ixopo, Ipolela, Impendhle, Lions River, Richmond, Estcourt.

(*d*) *Movements.*—The general improvement is reflected in the reduction of infected flocks which arrived at the abattoirs. The following statement of stock received at the Johannesburg, Maitland, and Pretoria Abattoirs during the year shows the number and percentage of infection found:—

Locality.	Consignments.	No. of Sheep and Goats.	Consignments Infected.	No. of Sheep and Goats Infected.	Percentage of Infection.
Johannesburg:					
From origin other than South-West Africa	5.262	551,855	17	1,281	0·32
From South-West Africa ...	209	33,362	1	100	0·48
Maitland:					
From origin other than South-West Africa	1,180	277,899	20	9,326	1·69
From South-West Africa ...	219	55,923	2	1,284	0·91
Pretoria:					
From origin other than South-West Africa	434	69,902	3	237	0·69
From South-West Africa ...	4	211	—	—	—

3. *Return of Flocks Quarantined,* 1924-1925.

Province.	Local.	Contacts.	Introduced.	Total.	Percentage of Infection.
Cape	1,717	489	495	2,701	4·29
Transkei	2,393	1,157	44	3,594	3·71
Bechuanaland ...	384	286	51	721	10·21
Transvaal	415	1,062	70	1,547	3·39
Natal	858	920	35	1,813	3·92
Orange Free State...	45	22	23	90	0·32
Union ...	5,812	3,936	718	10,466	3·65

REPORT No. II.—VETERINARY EDUCATION AND RESEARCH.

Director: SIR ARNOLD THEILER, K.C.M.G., D.Sc., ETC.

1. *Staff*.—Dr. E. V. Cowdry of the Rockefeller Institute, New York, who arrived at Onderstepoort in June, 1924, returned to America in February, 1925. Articles from his pen dealing with the results of his investigations will be published in the Eleventh and Twelfth Report of the Director of Veterinary Education and Research early in 1926. Dr. H. Berg, from the Bayer Chemical Works at Leverkusen in Germany, who had been spending two years at this laboratory with the object of trying the effect of the famous drug, Bayer 205, on cattle and other animals infected with Nagana, completed his work early this year and left South Africa in April, 1925. A full report describing the experiments and the results at which he arrived will be published in one of the forthcoming reports of this Division. The Onderstepoort Laboratory was also honoured by a lengthy visit from Dr. A. A. Ayres, a Portuguese veterinarian from Lourenco Marques. Dr. Ayres spent several months at the laboratory in order to acquaint himself with the methods of research adopted here and other matters relating to animal diseases in South Africa. Professor Dr. Max Kupfer of the Federal University of Zurich, Switzerland, came to Onderstepoort, to undertake investigations into the physiology of the Oestrus cycle in equines and other domesticated animals, and from the results of his work obtained so far, it is evident that very valuable information will be obtained for the veterinarian and the breeder, both abroad and in this country. In October, 1924, Mr. M. W. Sheppard left for Edinburgh to do special work in pharmacology and toxicology with a view to a lectureship in these subjects in the Veterinary Faculty. Mr. Sheppard is expected to be away for twelve months. Early in 1925, the professional staff of the Division was augmented by the appointment of three of the first B.V.Sc. graduates of South Africa, Messrs. J. Quin (who graduated with honours), W. J. B. Green, and C. Maré. Mr. Maré was transferred to the field staff later on in the year and replaced by Mr. J. H. R. Bisschop, another of the first graduates, who, in the meantime, had been carrying out the duties of a lecturer in Zootechnics at the Transvaal University College.

2. *Routine Work*: *Laboratory Products*—(i) *Anthrax*.—During the year ended 30th June, 1925, 1,983,505 doses of anthrax vaccine were issued, showing a decrease of 209,170 doses on the issues of the previous year. Extensive outbreaks of the disease in enzootic form were not encountered during the year, and this may explain the small decrease in the amount of vaccine used. Our anthrax vaccines continue to give most satisfactory results, so that the

policy of using different strengths of vaccine for the different classes of animals, and in the various parts of the Union, seems to have been fully justified. No serious complaints in connexion with either the safety or immunizing properties of the vaccine were received during the year.

Until recently the goat has been the most difficult animal to immunize with safety against the disease. A relatively large percentage of goats shows a great susceptibility to anthrax, so much so that from 10 to 30 per cent. will be killed if injected with the ordinary vaccines (both local and imported) intended for the inoculation of other classes of animals. The difficulty of immunizing goats has now partly been overcome by the use of a particularly weak vaccine, which appears to answer well in practice, both as regards its safety and immunizing properties.

(ii) *Quarter Evil.*—The new liquid vaccine continues to give excellent results, and during the year it has been possible to make further improvements in connexion with its immunizing value. Experiments carried out under laboratory conditions have shown the vaccine to confer a solid immunity which lasts for at least a year. It seems probable that under natural conditions animals may be protected for an even longer period. Not a single complaint concerning breakdowns in immunity during the twelve months subsequent to vaccination was received, and it is now clear why there has been a definite decrease in the amount of quarter evil vaccine used annually in the Union: with the old powder vaccine, farmers were obliged to reinoculate their young stock repeatedly, sometimes as often as three times during a single year, whereas with the new vaccine it is never necessary to inoculate more than once annually, and in many cases the one inoculation is considered sufficient to carry the animals over the susceptible period. Less quarter evil vaccine is used in the Union, but the results are far more satisfactory than those obtained with the old powder vaccine.

During the year 252,170 doses were issued, as compared with the previous year's issues of 265,955 doses. We have now stopped completely the issue of powder vaccine, even to farmers who specially ask for it; applicants are advised to use the new liquid vaccine, a detailed explanation of its superiority over the powder vaccine being forwarded in each case.

(iii) *Contagious Abortion.*—Reports from different parts of the country still go to show that the disease is widespread, but attempts to bring it under proper control are made in only rare instances. Most farmers do not understand the true nature of the disease nor the methods of control recommended by the Division. Vaccination also is not generally adopted, and this is reflected by the annual issue of vaccine, which amounted to only 2,073 doses during the past year. In order to encourage vaccination against the disease, even in cases where the value of the cattle concerned is not very great, the question of reducing the price of the vaccine is under consideration.

(iv) *Redwater and Gall-sickness.*—The vaccine which is used as a preventive inoculation against these two diseases continued to give satisfactroy results; during the year 10,186 doses were issued.

(v) *Glanders.*—Mallein, the diagnostic agent employed in this disease, is still being made by the Division and issued free to Government veterinary officers. During the year 6,009 doses were issued. Under the conditions prevailing in South Africa the so-called "eye-test," for which concentrated mallein is employed, gives by far the best results; the ordinary or subcutaneous test has proved unsatisfactory.

(vi) *Blue-tongue.*—As was expected, the exceptionally wet weather experienced during last summer resulted in very severe outbreaks of the disease in different parts of the country. The wise sheep-farmer anticipated this and carried out vaccination in good time, but many delayed this essential precaution too long, with the result that heavy losses were encountered. Inoculation, although rather late in many cases, was practised extensively, the amount of vaccine issued constituting a record, namely, 2,392,800 doses, an increase over the previous year's issue of well over a million doses. During the year, fresh strains of natural *blue-tongue* were isolated in the field with a view to replacing the existing vaccine strain, which, it was feared, might in time get too weak to give the necessary immunity.

(vii) *Wireworm and other Worm Diseases in Sheep.*—During the year 11,634,400 doses of wireworm remedy were issued, which constitutes a record. As soon as it was realized that we were likely to have a particularly wet summer season, farmers were warned that parasitic diseases of sheep were likely to become troublesome, and that more extensive use of the wireworm remedy should be made. Some farmers anticipated this and started regular treatment of their sheep early in the season. Others used the remedy only spasmodically and many of the latter have experienced serious losses during the last few months. The wireworm remedy is designed primarily to eradicate stomach worms, but our experience, as well as that of some farmers, during the last few years has shown clearly that sheep which are kept free of wireworm have much greater powers of resistance against infection by intestinal worms, the more important of which are the nodular worm and the bankrot worm. Unfortunately, in spite of extensive trials, we have not yet been able to discover an effective remedy against the intestinal worms, so that all efforts must be directed towards keeping the sheep away from infection and towards building up and conserving their strength and vitality during the summer months. In order to improve the keeping qualities of the wireworm remedy in damp weather, and also to enable the farmer to inspect the product without opening the container, and so return for replacement free of charge any material which has suffered possible deterioration during transit, a new form of hermetically sealed container, with transparent celluloid top, has been adopted for future issues. The price of the remedy was reduced during the year from 1s. 6d. to 1s. per 100 doses.

(viii) *Inoculation of Mules against Horse-sickness.*—During the year 5,873 doses of serum and virus were issued for the inoculation of mules. The method continued to give good results, and very few owners now insure their mules before inoculation. The production of horse-sickness serum was continued on a fairly big scale in order that there would be a sufficient stock of serum should it be found possible to recommence the inoculation of horses in the field.

(ix) *Stock Dip Regulations.*—The advantages of these regulations are becoming more apparent each year, and it is satisfactory to record that manufacturers generally aim at meeting the views of the Department in every possible way. Analytical checking of guarantees has been limited owing to pressure of other work, but sufficient has been undertaken to show that manufacturers conscientiously endeavour to maintain standard composition. A short exposition of the regulations was published in the March, 1925, number of the *Journal* of the Department, and should assist in making the objects of registration more widely known to the farming community.

(x) *Stock Remedy Regulations.*—Regulations for control of sale of remedies for stock were introduced during the year (Notice No. 2130 of 22nd December, 1924), and numerous registrations were effected. Several years will elapse before the benefits of these regulations are fully felt, but they have already resulted in the withdrawal from sale of several useless nostrums, and in extensive modification of the extravagant, misleading claims of otherwise useful products.

(xi) *Dip-testing Materials.*—During the year 1,660 litres (equivalent to 166,000 tests) of dip-testing fluid, 1,500 tins of reaction powder, and 4,740 books of test-paper, were issued as "free service" to other Government Departments.

(xii) *Laboratory Dip-tester.*—Soon after this report appears in print, the laboratory dip-tester will probably be on the market and obtainable from this Institute.

3. *Routine Examinations*: (i) *Blood-smears and Pathological Specimens.*—During the year 16,890 blood-smears and pathological specimens were examined at Onderstepoort, 24,500 at Maritzburg, and 798 at Grahamstown. Farmers have been encouraged to send in pathological specimens for diagnoses, and the results have been satisfactory in that in many cases it has been possible to recognize certain diseases without the expense of sending an officer to the farm to investigate the causes of the mortality.

(ii) *Contagious Abortion Tests.*—Farmers do not make sufficient use of the serological tests by means of which we are able to make a definite diagnosis of contagious abortion in a herd. Many do not know of the test, while others make no attempt to find out the extent of infection in their herd, thinking that control is unnecessary or irksome, and that the disease must be allowed to run its course. During the year 3,027 tests were carried out, and of these 358 gave positive results.

(iii) *Examination of Sick and Dead Animals.*—Instead of research officers being sent to visit farms for the purpose of diagnosing unknown diseases, it is very often more convenient and cheaper to have dead or sick animals sent for examination to the laboratory by the farmer. Such cases are frequently met with in correspondence with farmers, who are then asked to forward affected animals for examination here. During the year many farmers have made use of this method, and the results have been extremely satisfactory, a definite diagnosis being made in many cases, and the owners advised of the best methods of preventive and curative treatment to be followed.

4. *Analytical Work.*—Excluding the numerous check analyses in connexion with the issue of wireworm remedy and dip-testing solutions, and the numerous analytical operations in connexion with specific researches, the number of samples recorded for the year in the chemical laboratory was 820. Of these 330 were poisoning cases; 100 dip-washes; 30 dipping materials; 130 foodstuffs; 50 bloods, urines, and pathological specimens; 40 stock remedies; and 140 miscellaneous. A noteworthy feature of these figures is the steadily increasing advantage taken by the farmer of the resources of the laboratory for the detection of poisoning cases.

5. *Administrative Work.*—The original estimates for the year totalled £85,687, and although half-way through it seemed that nothing short of an additional £5,000 could save an excess on the vote, the strict curtailment of expenditure at the sacrifice of some experimental work reduced the balance on the wrong side to under £1,000. It is, however, essential to point out again that for the last few years the appropriation has been reduced to the lowest possible figure, the result being that stocks of many items are seriously depleted, and in times of emergency local purchases had to be made at an enhanced figure. A reduction in the tariff rates of blue-tongue vaccine and wireworm remedy came into force in 1924, and the original revenue estimates were based on a reduction of blue-tongue vaccine from 1½d. to 1d. per dose, but on Treasury instructions the price was reduced to ½d. per dose. The total revenue accruing to the Division reached £26,038, in addition to which credit should be taken for the potential revenue of £28,500 which would have been received had it not been decided to issue anthrax vaccine free of charge. The policy of the last few years has been to issue laboratory products at practically cost price, and, with the general fall in cost of some raw materials, coupled with economies resulting from "mass production," very substantial reductions have been made on the tariff rates of 1921. Had those rates been in force during the past year, the revenue of the Division would have reached nearly £100,000.

Towards the end of the year an additional twenty-four acres of ground was put under cultivation to replace partly the land lost as a result of inundation by the waters of the Bon-Accord dam.

6. *Travelling and Extension Work and Demonstration Train.*—Every effort was made to get into closer touch with the farmers and to investigate their troubles at the scenes of the outbreaks. Considerable travelling was undertaken by the different officers of the Division, but the shortage of research officers is particularly noticeable, and unexpected calls were made for staffing the Veterinary Research coach of the Demonstration Train. In some instances, it was not possible to spare one officer for the whole tour, but arrangements were made for relief to be given at different centres. Further calls were made for lectures on farmers' days and farmers' weeks, and it has become quite evident that the original staff of twenty-nine research officers is inadequate for the additional calls that have since been made.

7. *Publications.*—The Ninth and Tenth Report of the Director of Veterinary Education and Research was published in July, 1924, and the policy of contributing frequent articles to the Department's *Journal* was maintained.

8. *Research Work*: (i) *Horse-sickness.*—Experiments into this disease were continued, mainly with the object of simplifying the method of inoculation so that it would become possible to apply the method in the districts, perhaps even on the farms themselves.

(ii) *Heartwater.*—Professor Cowdry's work has cleared up the problem of the cause of heartwater. We now know that this disease is produced by a very small micro-organism (*Rickettsia ruminantium*) which belongs to a group of organisms responsible for several diseases in human beings. The discovery in itself does not help us much in the treatment or prevention of the disease, but now that we know the cause, there is far more likelihood of progress being made in this connexion. Experiments have also been conducted during the year with a view to finding an attenuated strain which might perhaps be combined with the serum in such a way as to be serviceable in immunizing animals. It is too early yet to say whether the method is likely to succeed.

(iii) *Nagana.*—Dr. Berg, of the Bayer Company, concluded his work in South Africa, and was able to demonstrate that Bayer 205 in combination with tartar emetic conferred an appreciable measure of protection on cattle and other animals. The method is undoubtedly cumbersome and may not be practicable on a large scale, but we certainly have some means now of protecting animals for a considerable period. At Allerton, near Pietermaritzburg, experiments have been conducted during the last two years in connexion with the rôle played by insects other than the tsetse fly in the transmission of nagana in cattle and dogs. The experiments have yielded the provisional result that such transmission is possible under certain conditions. The work is being continued on a more extensive scale, and a report will be published later on.

(iv) *Snotsiekte.*—This disease made its appearance on a fairly extensive scale in the northern Transvaal, where it was shown that infection was carried by the blue wildebeest and was then transmitted to cattle. We know now that both the black wildebeest and the blue wildebeest are natural hosts of the infection, and must, therefore, be regarded with suspicion whenever they come in contact with cattle. The pathology of the disease is being investigated further.

(v) *Lamsiekte.*—Although the chain of factors which lead up to this disease has been known for several years, the actual bacteria which produce the toxin had not been isolated. During the year the bacteriological studies on this subject were brought to a successful conclusion, and an organism from the *Botulinus* group was isolated from infected material. Pure cultures of this organism produced a toxin which, when injected in very small quantities, gave rise to typical cases of the disease.

(vi) *Nutrition.*—Experiments were commenced during the year in which cattle were placed on definite rations in which the mineral and other constituents were accurately known. The intention was to find out the value of the various mineral constituents, and especially of their relative amounts. The vitamine factor was also taken into consideration in several of the experiments, and the provisional results have already borne out the correctness of our earlier conclusions that the vitamine requirements of cattle are

practically negligible. The experiments will be continued over several years, and it is anticipated that the results will be of very great value and interest.

(vii) *Sterility in Cattle.*—Investigations were commenced on a large scale with the object of finding out which factors are chiefly responsible for sterility of cattle in South Africa. Breeders all over the country were circularized, and an officer of this Division visited numerous farms where sterile cattle were present. A number of these animals were acquired by the Division, and these are now being kept under observation and treated where necessary. When ultimately these animals are slaughtered, a careful pathological examination of the organs will be made. It is hoped that new light will be thrown on the problem of sterility, and that much will be accomplished in the way of eliminating certain factors.

(viii) *Marico Calf Disease.*—This disease is always at its worst during very wet seasons, so that it was expected to cause a great deal of trouble to the farmers of the Marico District during the past summer months. These farmers were advised to commence early with the preventive inoculation referred to in the last Annual Report, and to repeat vaccination regularly at intervals of a fortnight. For this purpose several thousand doses of anti-paratyphoid vaccine were issued free of charge to all farmers applying for it, but at the time of writing all the results obtained from vaccination had not come to hand. We are not yet in a position, therefore, to form a definite opinion on the amount of success that has been achieved, but steps are being taken to collect all the necessary information. It is intended to carry out further investigations in connexion with the disease, and to improve the method of vaccination in the light of the further experience gained during the past season.

(ix) *Worm Infections.*—Investigations on this very important subject were continued right through the year, and many points were elucidated in regard to the life-histories of the various parasites. It was also found that, after the exceptionally wet season, many worms began to play an important economic rôle and caused serious losses, which formerly were only encountered in very rare instances. Investigations proved conclusively that the only way in which to tackle these worm infections, especially in sheep, was by means of proper farm management. Remedies, even if they should be discovered, would never be the ideal way of dealing with the various worm infections. The investigations are being continued, and it is hoped in the near future to conduct them on a large scale on an actual sheep farm where all the natural conditions and difficulties will be present.

(x) *Bloedpens.*—During the year, operations were commenced on a fairly extensive scale in the Springfontein area of the Orange Free State, where every year bloedpens causes heavy losses. The investigations are being continued, and a summary of the results will be published as soon as available.

(xi) *Scab.*—The experiments which were commenced several years ago were continued. Various proprietary dips were tested, especially with the object of determining their protective value. The experiments have not yet been concluded, but it appears that some dips will protect sheep against reinfection with scab for several days or even weeks.

(xii) *Keds.*—Similar experiments to those on scab were also conducted with sheep infected with keds. The life-history of this parasite is now fairly well known, and the chief point to settle is the killing properties of the various classes of dip on the market. The work is progressing favourably, and a final report will be published later on.

(xiii) *Dipping Experiments.*—The effects of various dips on ticks were investigated during the year. One point it was intended to settle was the value of arsenate of soda as a tick killer. The view usually accepted is that only the arsenite will kill ticks, and that, therefore, a dip becomes inactive as soon as the arsenite is oxidized to arsenate. Our recent tests seem to indicate that this is not so, and that the arsenate is almost as effective as the arsenite. The tests are being continued.

(xiv) *Physiological Plant Investigations.*—The work of the plant physiologist upon veld vegetation and climate in general, and in special relationship to phosphorus deficiency and nutrition of stock, was commenced at Armoedsvlakte in December, 1922. Valuable results were obtained in several directions, which it is hoped to duplicate partially at a later date in a typically styfsiekte area of higher rainfall. Similar studies in every characteristically different geographical area of the Union would be of great value, not only from a general botanical point of view, but from that of stock nutrition under conditions of drought. This wider field of work, however, lies somewhat beyond the scope of this Division.

The results obtained from the experiments at Armoedsvlakte include an explanation of the conditions under which *wilting* of grasses occurs, and of the transpiration behaviour of plants under drought conditions; the influence of wilting upon the metabolism of the grasses in regard to *chlorophyll* content, and distribution of carbohydrates in the plant; and the mineral metabolism of the plant under arid conditions, with special reference to absorption and distribution of phosphorus. These data correlate with the conditions under which malnutrition of cattle and the disease lamsiekte have been investigated by the Division, and new light has been thrown upon the important relationships between veld vegetation and the growth and health of cattle reared upon it. In addition, a few observations upon hydrocyanic acid formation during wilting of veld grasses have been made, and this may be important in relation to certain obscure cases of death and disease in live stock. The results of the investigations are being published.

(xv) *Poultry Diseases.*—This subject, which is becoming more and more important with the development of the poultry industry in South Africa, is receiving the serious attention of the Division. At the sub-station at Allerton, near Pietermaritzburg, investigations into the various diseases of poultry are being conducted on a fairly extensive scale. More accommodation in the way of isolation pens and breeding houses will be available in the near future, and it will then be possible to continue the work more intensively.

REPORT No. III.—FIELD AND ANIMAL HUSBANDRY.

Director: R. W. THORNTON.

1. *Scope of the Division.*—Considerable difficulty has been experienced in submitting this Annual Report, which covers certain Divisions, etc., of the Department and the Schools, as the major portion of the work involved was only taken over at the beginning of the present calendar year, and it will not be until next year that a full report can be submitted, as only then will the reorganization be completed. For the present, therefore, the various sections will be dealt with separately.

Working single handed throughout the year has hampered the reorganization of the work very considerably, but the undermentioned sections have received considerable attention:—

(a) *Sheep and Wool.*—This section has been organized and placed on a comparatively sound basis, and with the help of the Census Department every farmer throughout the Union has been notified of the conditions under which sheep-classing will be performed in the future.

(b) *Poultry Section.*—The work in this section is now satisfactorily organized and is making considerable progress.

(c) *Cattle Section.*—The first step in the form of a cattle survey has been taken to secure the necessary information which will enable us to carry out the systematic work so much needed in connexion with our cattle interests. Here, also, the Census Department assisted materially by distributing to farmers the forms by which it is hoped to secure the necessary information, and farmers generally are to be thanked for the manner in which they are filling in and returning these forms to this Department. It is anticipated that early next year a full report on this subject will be available which will show the present position and the lines to be followed in the future.

(d) *Pig Section.*—Apart from the cost-of-production and sunscald experiments, it has not been possible, due to lack of staff, to make the progress desired in this section; but the cost of production work alone will go far in demonstrating that this country can produce pig products at a sufficiently low cost to enable it to enter the European market on a satisfactory basis, provided that the quality of the products is of uniformly good standard so as to secure the good name that will ensure their sale.

(e) *Dairy Section.*—A very large portion of the time of the officers employed in this section has been taken up with regulatory work, but with the assistance of two or three additional officers it may be possible (i) to carry out the essential investigational work and (ii) to extend the system of milk recording so as to induce the culling of scrub and unprofitable dairy cattle which are retarding the entire dairy industry and making it impossible for its products to compete in the world's markets. With the revised recording scheme it is proposed to bring forward, will go the work of inducing the producer to undertake the

better feeding and management of his cattle. If we can achieve these two objects, the future of the dairy industry should be assured.

(f) *Cotton and Tobacco.*—Two outstanding features must be commented upon in regard to this section, viz., (i) the set-back that cotton growing has received in consequence of insect infestation, and (ii) the over-production of inferior tobacco leaf for which there is little or no sale. The matter of (i) has been taken up by the Division of Entomology, which it is hoped, with time, will overcome some of the worst difficulties depressing the industry to-day. As to (ii), soil and climate, over which we have no control, largely influence the production of heavy, dark, and inferior leaf. Everything possible, however, is being done to encourage the production of the light, high-quality leaf in areas where the soil and climate are suitable.

(g) *Horticulture.*—Here, also, there are two outstanding difficulties, viz., (i) the insufficiency of staff and (ii) the very serious question of what is to be done with fruit that is not of a suitable quality for export. The latter can only be satisfactorily dealt with by carrying out the necessary investigations, and this means an increase of staff and equipment; if this is not forthcoming, the fruit industry, which bids fair to become second only to our sheep and wool industry, will be seriously retarded.

(h) *Certain Crops*: (i) *Maize.*—The past season has seen the maximum yield of maize in the history of the country, but with the employment of a proper system of farming, the output could easily be doubled, and it is hoped that with the aid of the Central Maize Experiment Station, which is to be established, and of demonstration plots, this increased production per acre, so necessary if our production is to be on an economic basis, will be brought about during the next decade.

(ii) *Wheat.*—The question of a satisfactory wheat production has not progressed to any great extent, but much is expected of the Central Winter Cereal Experiment Station to be established in the south-western districts. With the aid of this station and the necessary demonstration plots, it is hoped in course of time to produce at least our own requirements. There is no reason why this should not be done, even if the only area considered is that lying between Mossel Bay and Cape Town south of the coast range, which can produce all the wheat we require and at the same time maintain more stock than it is carrying to-day.

(iii) *Other Crops.*—Most of the other crops have given good returns this season. The supply of potatoes exceeded the demand and the market reached a point below the cost of production. To assist this industry, comprehensive experiments with South African seed are being carried out at present, on behalf of this Department, in Great Britain, and it is hoped that, as an outcome, we may establish an export trade in seed or, at least, render it unnecessary to import seed.

(i) *Fencing.*—Great progress is being made, particularly in vermin-proof fencing. This means improvement in farming generally, and there is nothing that will more materially assist in the elimination of inferior or scrub stock than increased paddocking.

(j) *Distribution of Guano.*—A most encouraging feature is the increased use that is being made of guano as well as other fertilizers in the Transvaal and the Orange Free State. Producers are beginning to realize the benefits of better fertilizing to ensure increased production.

(k) *Schools and Experiment Stations.*—During the past year the Schools and Experiment Stations have carried out the greatest amount of work ever performed by them. There is the great danger, however, that extension work will outstrip investigational work, and that our extension officers, due to lack of the authentic data that is obtained from investigation, will become merely good guessers. Investigational work is the foundation on which we must build our teaching both within the Schools and amongst the public, and anything that tends to reduce investigation retards output. Reduction in output means a corresponding increase in the cost of production, and such increase handicaps this country when competing in the world's markets. South Africa is further handicapped more than any other country of a similar area in respect of its local markets owing to the small size of its European population.

Investigational work is therefore placed first in importance, and the degree of extension work must, to a great extent, be regulated by the force of men engaged on investigations, the results of which are made available to the extension officers, who in turn take these results practically to the producer's home.

The progress, generally, in field and animal husbandry has been satisfactory during the past year, with the possible exceptions of cattle and horticulture, where lack of staff has rendered it impossible to undertake the urgent work necessary for the welfare of these sections of our farming industry.

2. *The Schools of Agriculture and Experiment Stations.*—Reference should be made to the individual reports of the Principals. Certain points, however, must be emphasized, viz.:—

(a) *Extension Work.*—Despite the call made upon the Schools for the staffing of the demonstration train, there has been a considerable increase in their extension activities. During the year 1924-25, exclusive of lectures given on the demonstration train, 902 extension lectures were given to an attendance of 48,000 people, as compared with 1,060 lectures and an attendance of 44,000 in 1923-24. The number of farms visited also increased from 1.791 to 2,306. There was likewise an increase of 10 per cent. in the total number of letters answered by the various Schools. It was found impossible to satisfy the demand for extension lectures, and much had to be done at the expense unfortunately of experimental and teaching work,—an undesirable feature. The increased demand on the time of officers is reflected also in the smaller output of agricultural publications, which in 1924-25 fell to 90 articles, compared with 158 the previous year. Both Cedara and Glen report a better feeling between the Schools and the farming community than has been the case for some years past. This is an encouraging sign. The extension work has been planned, as far as possible, on practical economic lines. The following activities seem to have been more than usually successful:—

(i) The organization of egg-circles from Cedara, Glen, and Elsenburg.

(ii) The organization of seed growers' associations, five being formed—two for maize in Natal and two in the Transvaal, and one for potatoes in the Orange Free State. These associations will supply buyers with inspected, certified seed. The seed is inspected both on the land and in the bag by qualified inspectors. Its trueness to type can therefore be relied upon. The move is in response to a long-felt

want. Pure-bred seed is to the crop farmer what a pure-bred bull is to the stock farmer, yet hitherto it has been very difficult to obtain seed which was reasonably sure to breed true to type. It is hoped that as the number of associations increases the whole demand for true-to-type, free-from-disease seed will be met. The demand does exist; for instance, the Westminster Potato Growers' Association, the first seed association to place certified seed on the market, could have disposed of their surplus seed many times over, despite the bad slump in the potato market. The seed is disposed of under a registered brand, and in packages or bags sealed with lead seals which prevent any possibility of substitution.

(iii) The organization of wool growers' associations:—No fewer than twenty-four have been organized from Grootfontein; five more are in the course of formation, and with those in the other Provinces, make a total of forty for the Union. These associations, established with the assistance of the sheep and wool officers, have been of great value in promoting the correct skirting, classing, and packing of wool in accordance with definite standards, meeting the requirements of both producer and buyer. If the movement continues to progress as during the past four years our wool production should within the next decade be second to none in the world for correct, honest packing and quality. This year a further step in the right direction was taken by the associations already formed, which, with the aid of this Department, drew up the constitution and rules of a National Wool Growers' Association.

(iv) The unparalleled increase in vermin-proof fencing. Grootfontein has done much to forward this work.

(v) The system of wheat grading in the Western Cape Province worked out by Elsenburg in co-operation with growers and millers. It is hoped that this system will come into greater use as the number of elevators is increased, and so ensure the good farmer a fair return for his work.

(vi) The Maize-growing Competition for boys organized by the Potchefstroom School of Agriculture. This becomes increasingly popular, the number of entrants this year being 650, as compared with 600 last year. The benefit of this kind of work in turning the young mind towards agriculture, cannot be over-emphasized.

(b) *Experimental Work.*—Agricultural work at four of the five Schools was considerably handicapped by the wet season. Grain crops, while fair to good in yield, were generally low in quality and the hay crop poor. The continued absence of many of the senior officers on extension work was a further drawback. The time has arrived to consider the advisability of detailing certain officers for investigational work entirely. Unless this is done the investigational work on which our intra- and extra-mural teaching is based must suffer and data from other countries only will be available. Our farming and farm practice will suffer a serious set-back, as the problems of this country can only be satisfactorily overcome by our own investigators working in the areas where they occur.

In general, the work of previous years has been continued, any new work being confined to the major projects described in last year's report. Certain features of the new work merit attention, viz., :—

(i) The projected creation of a number of demonstration plots—one in the Elsenburg and two in the Grootfontein areas, one in the

Orange Free State, two in Natal, and perhaps one in Bechuanaland. This is a matter of considerable importance, as these plots will give data under practical farm conditions which are at present urgently required. The establishment of a special winter cereal station in the Western Cape Province and a summer cereal station in the Orange Free State will have a far-reaching effect on the system of farming and the many problems affecting cereal culture in South Africa, not the least of which is increased production per acre. The experiment stations at Pietersburg, Beginsel, Bathurst, and Hartebeestpoort are also securing valuable results from experiments.

(ii) The supervised co-operative experiments with farmers being carried out by each of the Schools, Elsenburg being worthy of special comment in this connexion. These experiments not only afford valuable generalized data, but also prove of interest to the farmer.

(iii) The cost of production studies. Cedara has made a particularly good start in this connexion in regard to cost of raising dairy cattle, beef cattle, and pigs under Natal conditions.

(iv) The increasing co-ordination of the experimental work at the various Schools. The project scheme introduced last year is materially assisting in this direction.

(c) *Students.*—The number of diploma students stands now at 301, compared with 288 in June, 1924, while the number of short-course students has increased from 1,269 to 1,387. The following table gives a summary of the situation:—

Courses of Instruction and Number of Students in Attendance during 1924-25.*

Description of Course.	Elsenburg.	Grootfontein.	Potchefstroom.	Cedara.	Glen.	Total.
Diploma Course	72	52	61	27	89	301
Practical Course	4	1	—	8	—	13
Special Courses:—						
Practical and Oversea Settlers	15	—	3	—	1	19
Sheep and Wool Course ...	—	31		—	—	31
Dairying Course	—			—	15	15
Cheesemaking Course ...	—	—	—	—	10	10
Student Assistants	—	—	5		—	5
TOTAL	91	84	69	35	115	394
Vacation Short Courses	199	346	313	123	406	1,387
GRAND TOTAL ...	290	430	382	158	521	1,781
Diploma Course, 1924	22	65	27	89†	85	288

* The return includes information as at a later date, in some instances, than that appearing in the individual school reports. In regard to the number of students attending the Winter Vacation Short Courses, the figures embrace the period 22nd June to 31st July, 1925.

† This figure includes some non-resident settler students. The capacity or housing accommodation, including sheep and wool students, is 86.

The number of practical students at Mariendal and Beginsel has also shown a tendency to decrease, there being at the former fifteen in 1925 as compared with twenty-six in 1924, and at the latter fourteen and twenty-three respectively.

The applications for short courses have, on the other hand, been very satisfactory, and both at Glen and Grootfontein it was not possible to accommodate all the students who applied for admission.

(d) *Staff Employed on Investigation, Teaching, and Extension at the Schools as at the 30th June, 1925.*

Description.	Name of School.					Total.
	Cedara.	Elsen-burg.	Glen.	Groot-fontein.	Potchef-stroom.	
Professional and Technical	16	17	13	21	13	80
Administrative and Clerical ...	3	5	4	7	6	25
Instructors and Assistants	7	14	12	18	18	69
TOTAL	26	36	29	46	37	174
June, 1924	30	35	27	43	25	160

(e) *General.*—One of the most encouraging features of the year's work was the increased co-operation between the Schools and the farming community, particularly in the Orange Free State, where the Glen School of Agriculture seems to be now commanding the respect of the Afrikaans-speaking section of the community.

Much good work has been done by the Schools in encouraging educative organizations among producers.

The cattle herds at the Schools did well generally during the year. Sheep at Potchefstroom and Cedara suffered on account of the wet season, but at Grootfontein did exceptionally well. A small but cheering sign is the increased interest being shown in the pig industry, especially in the Transvaal and Natal.

3. *Hartebeestpoort Experiment Station.*—This property was acquired in February, 1924, since when several buildings have been erected, 20 morgen of new lands broken up, a number of old lands placed in order, and 9 miles of fencing completed.

The staff consists of the manager (experimentalist) and an assistant. One European foreman and an average of sixteen natives have been employed.

Twenty-nine trek oxen and six mules have been purchased. Of twenty Cape cows purchased in the Darling District and immunized at Potchefstroom against gall-sickness and redwater, two died of tuberculosis and seven of heartwater. Of six heifer calves of these cows, four died at the station of gall-sickness and heartwater. An Ayrshire bull also died from heartwater. Continuous experiments

should be made in establishing a dairy herd, as the success of the settlements depends to a great extent on the dairy industry.

A considerable number of variety trials with tobacco, cotton, potatoes, mealies, field beans, monkey-nuts, and other crops have been undertaken, a particular feature being the costing figures on production which have been obtained for the more important crops grown on the station.

4. *Dairying.*—There are indications that the proportion of farm-made to factory butter has shown a further increase. This is most unsatisfactory, and the dairy industry cannot prosper if this condition continues. Uniformity in quality of butter can only be secured and maintained through factory manufacture, and it is only on uniform good quality that we can hope to build up our export trade, on which the future of the industry depends.

Unfortunately, the lack of confidence between dairy farmers and the creameries shows no sign of abating, and, with a view to surmounting this difficulty, the Superintendent of Dairying recommends the appointment of a strong committee of inquiry. The findings of a committee having the confidence of both producers and manufacturers should go far in establishing the closer co-operation and confidence between producer and manufacturer so much desired, for without it there is little hope of the industry making satisfactory progress.

Cheese-making is on a somewhat sounder basis, though the production last year was only 5,339,755 lb.—a decrease of 138,491 lb. on the previous year's output. The decrease is attributed largely, however, to the previous bad season.

A considerable quantity of dirty milk continues to be supplied to the cheese factories. As it is impossible to turn out a nice, clean, flavoured cheese from dirty milk, both producers and manufacturers suffer a reduction in the price they respectively receive for the raw product and the finished article.

Greater advantage is being taken of the services of the Department's cheese-grading officers. This will ensure the marketing of a greater quantity of cheese of a definite grade.

The position of the Government milk-recording scheme is becoming more satisfactory. The number of herds tested has increased from fifty-nine to eighty-three, and further increases are expected this year, farmers anticipating a favourable season and good calving percentages. Milk recording must be strongly encouraged. It is the most certain method that we have of putting a dairy herd on a profitable basis. During the coming year it is hoped to improve the present system of milk recording and to extend the scheme somewhat on the Scottish and Canadian lines. If farmers can once be induced to undertake the recording of milk yields, the elimination of the uneconomical dairy scrub by culling will follow, and with it the establishment of dairying in South Africa on a sound, paying basis.

5. *Sheep and Wool.*—The sheep and wool industry has been marked by extreme optimism on the part of farmers. Breeders have shown an increased interest in the improvement of their flocks. A larger percentage of the season's profits in mealies in the Orange Free State and the Transvaal has been expended in the purchase of Merino sheep and of better Merino rams. All this is much to the good.

Sheep farmers are commencing to realize the importance of veld preservation. The great expansion of vermin-proof fencing in the

Cape Province is spreading to the other Provinces, especially the Orange Free State, but there is still much room for improvement. It is only by a system of paddocking that the veld can be maintained in good condition and the greatest return be obtained from the sheep. The Report of the Drought Commission cannot be over-emphasized. It shows that unless the general methods of veld management are materially improved, this country is faced with the rapid deterioration of some of its best sheep-carrying areas.

The establishment of wool growers' associations has made rapid and satisfactory progress, forty having been formed to date, and most of these are on a firm foundation.

Experiments at Cedara show that the Suffolk and Merino is a satisfactory cross for Natal conditions, and that grain feeding on good Kikuyu pasture does not increase the growth of lambs. At Glen experiments are in progress to determine the relative income from six and twelve months' shearing, and on the hardiness of the Suffolk and Blackhead Persian cross. The Suffolk-Merino, and Suffolk-Blackhead Persian cross-breeding experiments at Potchefstroom will be of great value to mutton production in the Transvaal. From the Elsenburg co-operative experiments with farmers for mutton production, the average weight of lambs for the lamb trade should lead to a very profitable line of farming in that area. Experiments and investigations at Grootfontein cover a wide field, and include such work of national importance as that performed by Professor Duerden, of Rhodes University College, in collaboration with the School staff, on kemp and Merino wool-fibre generally. This work is still in progress, but the results already published have attracted world-wide laudatory comment.

The results achieved up to the present from the experiments on the effect of various paints and branding fluids on the wool fibre and manufactured article are of very great value. Blow-fly eradication investigations are also attracting the attention of Australia and America. Many other important investigations into breeding and other phases of Merino work, many of which have already been in progress for several years, continue to be carried out.

The extension work of the sheep section shows a healthy expansion. In 1924-25, 1,838 farms were visited; 568,164 sheep classed; 107,751 sheep advised upon; the wool of 73 associations classed; 290 lectures given; and 81 shows judged at. In 1923-24 the figures were, respectively, 2,105; 498,907; not available; 39; 252; and 54. It was not possible to answer all the calls made on the Department, and it is estimated that from five to six additional qualified sheep and wool experts will be required to handle all next season's applications for sheep and wool classing,etc.

The production of wool per sheep is increasing, a sure indication of the gradual elimination of scrub, the use of better rams, better management and farm practice generally; and a realization by the farmer that it is better to keep one sheep shearing 10 lb. of good wool than two each shearing 5 lb., as the two halve his grazing and double his expenses.

There is still a great shortage of good flock rams in the Union, and it behoves stud-breeders to open up new studs in new or backward areas and thereby secure profit for themselves and improve the Merino industry generally.

The progress discernible in the Merino industry during the past season, in the increased use of better rams, better management, increased paddocking, etc., makes it safe to predict that this industry will, at an early date, take a first place with Australia in the quality, etc., of its output of Merino wool.

The following tables provide interesting statistics of the industry:—

(a) *Number of Sheep and Goats in the Union.*

Sheep.

	August, 1923.	August, 1924.
Cape ...	15,383,142	15,428,525
Natal	1,323,531	1,477,209
Transvaal	3,319,009	3,473,304
Orange Free State ...	8,047,692	8,335,036
Union Native Locations, Reserves, etc. ...	3,150,372	3,288,774
Total	31,223,746	32,002,848

Goats.

	August, 1923.	August, 1924.
Cape...	4,545,010	4,284,297
Natal	405,656	427,464
Transvaal	447,706	456,311
Orange Free State...	171,246	159,988
Union Native Locations, Reserves, etc....	2,674,536	2,735,694
Total	8,244,154	8,063,754

(b) *Total Export of Wool*, 1924-25.

	Quantity, lb.	Value, £.
United Kingdom ...	75,330,391	7,204,664
Canada, Dominion of	15,807	2,557
India	4,828	383
Belgium	15,727,073	1,111,433
France	24,176,147	1,858,857
Germany	30,058,894	2,812,951
Holland	4,150,688	359,657
Italy	7,779,866	665,352
Sweden	630,310	60,326
Spain	81,190	6,076
Russia	5,730	130
Japan	241,274	26,541
United States of America	4,201,285	507,507
Total	162,403,483	14,616,434
Total, 1923–24 ...	162,738,353	12,876,054

(c) *Export of Mohair*, 1924-25.

	Quantity, lb.	Value, £.
United Kingdom*	10,747,644	853,719
France	6,834	305
Germany	27,496	1,024
Holland	1,963	180
United States of America	826,801	82,475
Total	11,610,738	937,703
Total, 1923–24 ...	16,087,379	1,114,120

(d) *Export of Goat Skins*, 1924-25.

	Quantity, lb.	Value, £.
United Kingdom	4,295,698	209,380
Canada, Dominion of	147,254	8,187
Australia, Commonwealth of	4,383	288
France	1,332,286	49,453
Germany	123,243	6,163
Holland	33,604	1,661
Italy	107,627	4,955
United States of America	1,309,532	72,703
Total	7,353,627	352,790
Total, 1923–24 ...	7,453,431	295,593

(e) *Export of Sheepskins*, 1924-25.

	Quantity, lb.	Value, £.
United Kingdom	12,402,647	839,943
Mauritius	400	24
France	9,415,306	590,314
Belgian Congo	120	3
Germany	227,628	15,084
Holland	135,709	5,615
Italy	4,365	269
United States of America	3,667,695	239,501
Total	25,853,870	1,690,753
Total, 1923–24 ...	29,792,324	1,578,796

The quantity of wool and of sheepskins exported has fallen slightly, though in value they show an appreciable increase. Mohair exported decreased considerably both in quantity and value. Skins, however, show an increase in both respects.

6. ***Brands***.—During the year, 414 European and 133 native brands were registered. The total number of brands registered as at the 30th June, 1925, was:—

Transvaal	28,274
Orange Free State	1,650
Cape...	6,169
Total	36,093

As there is no Brands Act in force in Natal, no figures are available for that Province.

7. *Poultry*.—This industry is making steady progress, much of which is due to the assistance rendered by the Acting Chief Poultry Officer and his staff, which, including lecturers and assistant lecturers at the Schools and officers paid from the Levy Fund, now stands at a total of fourteen officers. Apart from the lectures, demonstrations, judging at shows, and culling of birds, etc., performed by the School officers, the work of the itinerant officers appointed under the Egg Levy has been of an extensive nature, as indicated by the following figures:—

Lectures	189
Attendance at lectures	11,663
Demonstrations	90
Attendance at demonstrations	2,947
Farms visited	607
Birds culled	56,282
Shows judged	56
Conferences attended	33

As these officers are engaged on egg inspection either for whole-time or part-time during four months of the year, it will be realized what a wide field of work has been covered.

The 1924 export of eggs constituted a record. No fewer than 72,281 cases of eggs of thirty dozen each were shipped, compared with 1,927 cases in 1914, when the export of eggs was first started.

The number of egg circles did not increase during the year, but that those already established have considerably strengthened their position is manifest by the fact that the percentage of "egg-circle eggs" in the general export increased from 2.9 per cent. in 1922 to 13.4 per cent. in 1924. It is hoped that in the near future a central poultry exchange may be formed to which all egg circles will affiliate. This body will then take the place of the present standing committee, but will have a wider field of operations and will deal with the question of marketing and the co-operative purchase of poultry foods. The quality of eggs submitted for inspection was, on the whole, satisfactory, though at Cape Town it was found necessary to reject nearly 300 cases and 400 cases at Port Elizabeth. The eggs arriving in London were favourably commented upon, and fully maintained their good name on that market. The prices realized in October-November were slightly in advance of those ruling in 1923, but a market fall, attributable to the exceptionally mild winter experienced in Europe during 1924 and a consequent increased output, occurred in December, 1924.

The 14-lb. pack (per 120 eggs) instituted last year in place of the 13½-lb. pack has not proved a success, and it has been decided to revert to the original 13½-lb. pack, as exporters experience difficulty in selecting eggs of the correct weight for the 14-lb. pack. Further, the margin between it and the 15-lb. pack is too narrow.

A commencement is being made with the erection at Glen of the pens for the Central Egg-laying Competition, which will take the place of the separate competitions run at Cedara and Potchefstroom in past years, and afford one big official testing centre for the Union.

Increased attention is being given to investigation and experimental work, a very necessary side of poultry work in South Africa; with the addition to the staff of a specially trained officer and the co-operation of the Director of Veterinary Education and Research, far more work of this nature will be undertaken in the future.

(8) *Horticulture.*—There has been a considerable expansion in the export of citrus and deciduous fruits, but a further decrease in the export of dried fruits. Owing to the rapid increase in the export of citrus fruits and to unfavourable weather in the early part of the season, there was unfortunately some wastage at the ports. It was, therefore, deemed advisable to institute a repacking station. This station saved the growers a large quantity of fruit. A feature of the increase in deciduous fruit export is the entry of the Transvaal into the trade. The Transvaal fruit has the advantage of reaching the overseas markets before the Cape fruit is ready, and when there is no other deciduous fruit available. There is abundant promise of a profitable trade being built up for Transvaal fruit-growers.

During the year Dr. H. J. Webber paid a visit to the Union and Rhodesia. His exhaustive and valuable report has already been published, and it is hoped that all fruit growers will make themselves familiar with his recommendations.

There is little doubt that within the next five or six years the export of citrus fruit will reach a very high figure, estimated at from five to seven million cases. With this prospect, it behoves all concerned to consider the future very carefully, particularly the haulage and freight to remove this crop from the groves to the consumer, and the utilization of inferior fruit not suitable for export as fresh fruit to the European markets.

The maize and cotton export season coincides to some extent with that of citrus, and as the production of these two crops is also rapidly increasing they must be taken into account. Close co-operation between the Railway Administration and Agricultural Department will be necessary to forecast correctly the transport requirements of the Union. This question of haulage and freight should be considered early by a competent committee.

The satisfactory utilization of inferior fruit lies at the very root of the fruit industry. Only a small percentage of the total fruit produced is of a sufficiently high-grade quality to compete favourably in the overseas market, and that our local market is a very restricted one will be particularly appreciated from the fact that our climate enables even the townsman to produce a certain amount of fruit in his back garden, and so to meet largely his own requirements. Deciduous fruit does not present as much difficulty as citrus. There are many channels by which inferior deciduous fruit can be disposed of, such as the manufacture of jam and fruit pulp, yet we import large quantities of the latter from Australia instead of producing our own requirements and exporting to England as does Australia. The investigations being carried out at Elsenburg on the SO_2 (sulphur dioxide) content of dried fruit for the European market, and the proposed investigations into dehydration, will also materially assist in the disposal of deciduous fruit.

The utilization of inferior citrus fruit is far more difficult. In the first place, it behoves every producer to reduce to a minimum the

output of inferior fruit by working over all trees which produce inferior fruit, and fertilizing and otherwise caring for the grove and the individual trees therein so as to increase to the maximum the production of good exportable fruit. This will tend to reduce the amount of inferior fruit produced, but will still leave a huge surplus of fruit for the use of which every possible channel must be explored, otherwise it is feared that many groves will be reduced to a non-paying basis. It will therefore be necessary to investigate such questions as dehydration of citrus, the manufacture of essences and extracts, and, possibly, the exploitation of markets in India and the East generally which possess a large fruit-eating population. Citrus growers must realize that much of the fruit exported to-day will with difficulty compete in quality with the American article. American expansion in Europe is only in its infancy, and it is well known that a market once captured is difficult to recover, and is usually only recovered by a better article. The foregoing must not be regarded as a pessimistic outlook. The future is absolutely sound if we make provision now to meet its requirements. In regard to inferior fruit, indeed, the question is hardly one for the future; it is with us now, and the problem will intensify year by year.

The use of suitable standardized containers for the marketing of fruit in South Africa is receiving close consideration. Australia and the United States have such standardized containers for local marketing. The smaller containers are multiples of the largest one, which facilitates transport by rail and brings about a marked improvement in the get-up of the article by the producer, leading to an enhanced return and increased purchases of fruit by the consumer, particularly for the small householder. It is, therefore, hoped that the efforts being made in this direction will receive the whole-hearted support of the producers

9. *Viticulture.*—The vintage this year, although it has varied considerably in different areas, has been a fair one. The feeling in the industry seems to be more optimistic than it was last year.

Experimental work has been considerably broadened and arrangements have been made to take over the direction of all the viticultural work at the Elsenburg School of Agriculture. The usual research work at the Paarl Viticultural Station, Elsenburg School of Agriculture, and at the Oenological Institute has been continued. A new short course in wine-making was given at Elsenburg, and a three days' course of a similar nature at Montagu and Worcester. At the latter town the course was particularly successful, and it is hoped in the future to extend these courses to other centres. The Government Wine Farm at Constantia has been handicapped by the disorganization which has naturally followed on the decision to close down the farm. Every encouragement was given by the viticultural section towards establishing an export wine trade to Europe. As a result, farmers exported direct 32,162 gallons of wine during the year, which brought in £2,770, or almost £11 per leaguer.

It is hoped that the production of raisins and wines of different types will gradually become confined on broad lines to the most suitable areas. This will result in a more uniform type of product of high quality, and discourage the production in any area of an article that can be better produced in another. Our markets will in this way be beneficially affected.

10. *Tobacco.*—The 1923-24 tobacco crop showed a decline, being approximately 11,750,000 lb. The spring of 1923 started very dry and it was difficult to obtain good stands. Again, during the curing season, continuous rains caused a large percentage of dark low-grade leaf. The present crop (1924-25), although it has suffered from heavy rains, is of better quality. On the whole, the prices for the better grades remained fairly steady.

Unfortunately, owing to unfavourable soil and climatic conditions, a considerable amount of inferior leaf is produced which is more or less a drug on the market. On the other hand, the demand for tobacco suitable for cigarette manufacture cannot be fully met.

The Turkish tobacco crop suffered heavily from wildfire, in consequence of which the quality was not up to the usual standard. A pathologist (Division of Botany) has been appointed to study the disease.

11. *Cotton.*—Though heavily damaged by floods, washaways, and insect attacks, the 1924-25 cotton crop is more than double that of the previous season and will amount to about 15,000-16,000 bales of 500 lb. each. The phenomenal interest in cotton culture continues, and large stretches of ground are being cleared and prepared for the 1925-26 crop, so that if anything like a favourable season is experienced, and the ravages of insect trouble can to some extent be overcome, a production of 30,000 bales of lint may be expected.

The assistance of the officers of the Empire Cotton Corporation has meant a great deal to the Department in the investigational work at present under way. The comprehensive range of experimental and investigational work at the experiment stations was continued this season, a special feature, and one likely to prove of great importance to the industry, being the propagation of jassid-resistant cotton. It has been decided to lay out eighteen series (sixty plots each) of fertilizer plots in different parts of the cotton-belt to study the fertilizer requirements of the crop and to continue them for a period of at least four or five years. No such comprehensive fertilizer experiments with any crop have yet been undertaken, and the results should furnish a basis for the fertilizer requirements of this crop throughout the cotton area of South Africa.

There has been an increased demand for training in cotton growing. The students' hostel at Rustenburg has its full quota and about sixty names are on the waiting list; a sum of £9,000 has been set down for the enlargement of the hostel and offices.

Excellent work in grading has been done, and the adoption by the Department of a rigid system of cotton grading under regulation has contributed greatly to the excellent reputation South African cotton enjoys overseas. No other cotton-growing country has a better system of grading and baling. A note of warning must, however, be sounded: unless additional supervision and care can be given the grading of seed-cotton at the ginneries and the actual running of the gins, we are likely to lose our good name. This will be brought about by incorrect, or what might be termed wrong or false packing owing to ignorance, and the presence of a high proportion of nep, possibly caused by working in immature cotton and faulty running of the machines.

The following extracts are taken from a report by the Division of Tobacco and Cotton, and show clearly the progress of the industry as a whole:—

(a) Annual production of cotton lint in the Union: 1923-24, 3,824,442 lb.; 1924-25, 7,500,000 lb. (approximately).
(b) Approximate areas planted, 1924-25, Union and Swaziland, 60,000 acres.
(c) Potential areas suitable for cotton: Union and Swaziland, 4,000,000 acres (approximately).
(d) Number of ginneries in the Union: Union 18, Swaziland 2.
(e) Number of Societies affiliated to the Central Co-operative Cotton Exchange: Union 9, Swaziland 1, Northern Rhodesia 1.
(f) Number of technical officers of Tobacco and Cotton Division: (i) Department of Agriculture—administrative, 1; tobacco and cotton, 7; entomology, 1. (ii) Empire Cotton Growing Corporation—entomology, 2; chemistry, 1; plant breeding, 1; other, 1. Total, 14.
(g) Number of cotton fertilizer experiments planned: 18.
(h) Number of pure-seed multiplication farms under Departmental supervision: 10.
(i) Statement of cotton levy funds—

Receipts to date						£3,509	6	4
Expenditure—								
Cotton Exchange to date		£2,250	0	0				
Hesse's trip, 1923-24 ... ... (Visit to Europe for studying and reporting upon marketing of cotton)		200	0	0				
Professor Webber's visit to Union ...		150	0	0				
						2,600	0	0
Balance ...						£909	6	4
Commitments—								
Co-operative manurial experiments...		£500	0	0				
Scholarships, 3 at £200 each... ...		600	0	0				
Insectary, erection of		250	0	0				
Cotton Exchange—								
Authorized £2,000 for administration								
500 for propaganda								
	£2,500							
Less paid this calendar year ...	1,400							
		1,100	0	0				
						2,450	0	0
Deficit to be met by this season's levy						1,540	6	4
Estimated receipts from season's levy						3,750	0	0
Estimated balance						£2,209	13	8

12. *Guano Islands.*—The 1924-25 season was not a good one. From a rough estimate, the guano at present being collected will amount to about the same or a slightly lesser tonnage than that collected last season. As the demand for guano is increasing, especially from the Transvaal, a further shortage in the amount to be allotted, as compared with the quantity asked for, must be expected. The total number of applications for guano received during 1924 was 5,316 for an aggregate quantity of 17,749½ tons, as compared with 4,383 applications for 13,292½ tons the previous year. The total quantity of guano disposed of throughout the Union between July, 1924, and 30th June, 1925, was 9,874 tons.

The sealing season was very successful; the total number of skins secured was 16,438, which sold at an average of £1. 17s. 7d. per skin, as compared with 11,223 skins at £1. 9s. for the previous year.

13. *Friesland Cattle.*—Considerable assistance in technical matters was rendered to Friesland breeders in this country by Professor J. H. W. T. Reimers, of the University of Stellenbosch, who visited and advised forty-five Friesland breeders, wrote seven articles on Friesland matters, judged at two shows, and reported in detail on the Rosebank, Bloemfontein, and Johannesburg shows He stated that the prices for Friesland cattle are still at a low level, and that the lack of demand for Friesland bulls is due to the low price of dairy products, which discourages the keeping of high-priced dairy cattle. Professor Reimers reported that Friesland breeders have still much to learn about the feeding of young stock. The number of young cattle lacking in size and proper development is very large.

The following reports on specific branches of this section of the Department are published hereunder, viz.:—

- (*a*) Agricultural Education:
  - (i) Elsenburg School of Agriculture and Experiment Station.
  - (ii) Grootfontein School of Agriculture and Experiment Station.
  - (iii) Cedara School of Agriculture and Experiment Station.
  - (iv) Potchefstroom School of Agriculture and Experiment Station.
  - (v) Glen School of Agriculture and Experiment Station.
- (*b*) Superintendent of Dairying.
- (*c*) Chief (Acting), Division of Tobacco and Cotton.
- (*d*) Chief, Division of Horticulture.
- (*e*) Viticulture:
  - (i) Government Viticulturist.
  - (ii) Government Wine Farm, Constantia.
- (*f*) Superintendent, Government Guano Islands.

No. III (a).—AGRICULTURAL EDUCATION.

(i) Elsenburg (Cape) School of Agriculture and Experiment Station.

Principal: W. J. LAMONT.

1. *Staff.*—The staff at 30th June, 1925, comprised 17 professional and technical officers; 5 administrative and clerical officers; 14 instructors and assistants—total 36. There were, during the year, 8 appointments and 11 resignations.

2. *Courses of Instruction and Students.*—(*a*) Little or no change was made to the regular courses. The following statement shows the number of persons who received instruction during the year:—

Diploma course: Enrolment and students in residence ...	62
Practical students: Elsenburg	4
Practical students: Mariendal	15
Short courses: July, 1924	102
Short courses: June, 1925	39
Wine-making course	15
Total	237

Numbers of students for the regular diploma course showed a slight falling off, but the short courses are gaining in popularity, and those just concluded showed a record enrolment. In addition to the above, it should also be mentioned that this year an experiment was made in holding short three-day courses in wine-making at Worcester and Montagu. The daily attendance at these lectures was 70 and 25 respectively. Due presumably to other branches of farming offering more attractive prospects to settlers, considerable reductions were shown in the numbers of students enrolled for the practical course at Mariendal. It was accordingly decided to discontinue this course as from 31st July, 1925.

(*b*) *Examinations and Diplomas.*—Of the 23 students who presented themselves for the final examination at the close of 1924, 4 were awarded honours diplomas, 10 received first class and 8 second class diplomas, while 1 failed to pass. Of the junior students, 20 were successful in part I of the course.

(*c*) *Inspection Visits.*—As a regular part of their various courses of instruction, visits were paid by students to the Rosebank show; Imperial Cold Storage farm at Porterville Road; South African Railways and Harbours stables, Cape Town; grain elevators; Imperial Cold Storage stores; Constantia Wine Farm; United Tobacco Company; Harbour Cold Stores; and the Kirstenbosch Botanic Gardens.

(*d*) *Competitions.*—In the inter-school live stock judging competition held at Johannesburg, in September, 1924, Elsenburg secured second place. Stock-judging competitions were also held at the Rosebank show, in which nine students participated.

3. *Publications.*—In addition to monthly notes and replies to queries through the agricultural Press, twenty-six articles were prepared for publication by members of the staff.

4. *Extension Work.*—This section of the Institution's work showed a very great increase during the past year, when 4,378 inquiries were attended to by correspondence; 204 lectures and demonstrations were given in the area, with a total attendance of 9,650, showing an increase of practically 100 per cent.; 60 engagements to judge at agricultural shows were fulfilled, and 877 farm and poultry yards visited by the staff. In addition to this work in the area, a great deal of what is actually extension work is done at the School. Three conferences were held at Elsenburg, viz.: the Annual Conference of Western Province Grain Farmers, the Cape Dairymen's Association Conference, and the Annual Poultry Conference. The staff of the School also attended numerous meetings of breed societies, farmers' associations, and agricultural societies, and the usual annual congresses of the central farmers' organizations.

5. *Experiments and Investigations.*—This class of work remained practically the same, except that a large number of co-operative experiments with farmers were undertaken. The kind of investigations is determined in the first instance by local problems, and in consequence fertilizer tests, cereal varieties, and fodder crops take an important place. Since the last report was published, the establishment of an experimental farm to be situated in some central locality in the grain-producing area has been agreed to. A plot of thirty acres on the Olifants River irrigation scheme was also set aside for demonstration purposes. These two farms will be of inestimable value for experiments under farm conditions, and will afford opportunities under comparable conditions of demonstrating systems of farming.

6. *Shows and Exhibitions.*—A large exhibit, featuring certain phases of the Institution's work, was staged at the Rosebank show and was very favourably commented on by the public and the Press. Fruit and viticulture exhibits were also arranged for the Empire Exhibition.

7. *Live Stock and Crops*: (*a*) *Annual Sale.*—The annual sale was well attended and realized £1,418. 13s.

(*b*) *Live Stock.*—The numbers of live stock on hand at 30th June, 1925, were as follows:—Cattle: Friesland, 43; Jerseys, 40. Pigs: Large Black, 30; Tamworth, 25; Berkshire, 20. Sheep: Suffolks, 89; Dorset Horn, 29; Merinos and Crossbreds, 45.

All classes of stock did well. The high standard of production of the Friesland and Jersey herds was maintained, and co-operative experiments are in progress in the production of cross-bred lambs. A limited number of Suffolk and Dorset Horn rams was loaned to farmers, and despite an unfavourable season the weights at the initial tests were very gratifying. Careful records will be kept of the weights reached by time of disposal, as well as dressing percentages after slaughter. Last year's drop of cross-bred lambs from the School were sold at 25s. each, at an average age of 6½ months.

(*c*) *Area under Crops.*—Generally speaking, the winter season was a favourable one, but the summer was exceptionally dry, and summer fodder crops suffered in consequence. The areas under crop were, in acres, as follows:—Oats, 170; rye, 10; oats and vetches, 39; soiling crops, 45; maize for silage, 36; rape on braakland, 130. The total area now under Kikuyu grass is 35 acres.

(*d*) *Labour.*—The average wages for adult white labour during the year was 4s. 9d. per diem, and 3s. per diem for coloured.

8. *Development Work.*—Three houses to accommodate married members of the staff at the School are nearing completion. A duplicate engine in connexion with the electric lighting plant was erected; and 8,000 gum and pine trees were planted on various parts of the farm. Two additional brick houses were erected in the poultry division, and a new boiler installed in the dairy.

9. *Mariendal Farm.*—This farm is now being conducted as a part of the Elsenburg farming operations. More that one-half of the grade dairy herd was transferred to other institutions. The area under crops of various kinds was 290 acres. The orchards made excellent progress and in a few years should give excellent revenue returns. Owing to irrigation facilities which are available, it is proposed to transfer a great deal of the horticultural nursery work from Elsenburg to Mariendal.

10. *General Remarks.*—A great deal of work was done by the School in connexion with the fixing of grades for wheat primarily to fit in with the operation of the South African Railway elevator erected at Moorreesburg. Several conferences were held and grades fixed. It might not be out of place to mention that the marketing of the western Cape Province grain crop is a subject which requires some attention. The present methods whereby little or no discrimination is shown in the price paid for various grades offer scant encouragement to the good farmer. The adoption of grades will not play the part it should, when only a very small percentage passes through the one elevator at Moorreesburg. Moreover, the fact that there is only one elevator will make practically no difference to the general method of handling the crop. For practical purposes the grades will be applicable to that portion of the crop which is dealt with by the elevator. The erection of more elevators in the grain districts is probably the only means by which grain will be sold according to grade, unless a radical change takes place in existing methods of marketing and wheat is purchased on a quality basis. It is understood that this matter is engaging the attention of the Board of Trade and Industries.

The question of utilizing live stock in conjunction with grain farming is receiving earnest attention, and it is hoped that experiments on the new farm will serve to indicate the interdependence of live stock and grain farming, and the importance in the western districts of a greater diversity of interests than is generally the case.

Important alterations were effected in connexion with the handling of fruit for export. Additional quayside cold storage accommodation is being provided on an extensive scale, and a Fruit Shipping Control Board brought into existence to regulate shipping matters.

Great strides are being made in poultry in the area, and the appointment of a special itinerant officer is being attended with excellent results. During the eight months this officer held no fewer than ninety-one lectures and demonstrations, and was instrumental in the formation of numerous poultry societies and egg circles. The success of this work is an indication of the need of similar officers being attached to other sections of the School.

Several conferences in connexion with dried-fruit interests were held during the year, and the appointment of an officer specially to deal with dried fruit should prove of great benefit. Investigations into methods of controlling the sulphur dioxide (SO_2) content of some of our dried fruits are in progress in order to ensure compliance with the import regulations in European countries.

(ii) Grootfontein, Middelburg, Cape, School of Agriculture and Experiment Station.

Principal: M. J. JOUBERT, B.S.A.

1. *Staff*.—As at 30th June, 1925, the staff consisted of the following number of officers:—Professional and technical, 21; administrative and clerical, 7; instructors and assistants, etc., 18; total, 46.

2. *School*: (*a*) *Courses of Instruction*.—Two years' diploma course; special sheep and wool course (8 months). *Short Vacational Courses* (*5 days each*) in domestic science; 3 courses sheep and wool; poultry; dairy cattle and field crops; horticulture, apiculture, and entomology; dairying and pig husbandry; 10 wool growers' association courses (3 days each).

(*b*) *Students*.—The number of students enrolled in 1925 for the regular courses was:—Seniors, 22; juniors, 33; sheep and wool, 31; total, 86. There are no settler students this year. Thirty applicants for the special sheep and wool course, who sat for the entrance examination, could not be considered on account of lack of accommodation. The number of students enrolled for the short vacational courses in June-July, 1925, and the wool growers' association courses (wool classers' courses) in the spring of 1924 was 503.

Of the total of 162 members from wool growers' associations who attended the courses, 74 qualified as wool classers. Out of 56 students attending the regular courses only three divorced themselves from farming pursuits on leaving Grootfontein.

(*c*) *Educational Tours*.—The special sheep and wool students visited some of the leading breeders in the Middelburg, Graaff-Reinet, and Steynsburg Districts for the purpose of gaining additional experience and practice in judging, classing, and mating sheep. The students also attended the Queenstown and Bloemfontein spring shows.

A team of five students from the diploma course competed in the inter-school judging competition at the Witwatersrand spring show.

3. *Extension Work.*—A considerable expansion took place in the extension work during the past year, as shown in the following table:—

	Inquiries.	Lectures and Demonstrations.	Average Attendances.	Total.	Number of Shows Visited.	Visits to Farms.
Total, 1924-25 ...	12,471	213	797	16,968	61	567
„ 1923-24 ...	12,357	158	—	8,835	53	449
„ 1922-23 ...	11,319	143	—	6,152	62	770
„ 1921-22 ...	7,645	106	—	4,416	69	540
„ 1920-21 ...	6,774	69	—	3,345	47	314
„ 1919-20 ...	7,024	24	—	1,841	—	171

This increase has only been made possible by the careful organization and timing of the activities of the staff.

During the period under review 89,543 sheep were classed.

The number of wool growers' associations in the Cape alone is 24, and 5 are in course of formation. This number would have been exceeded if facilities existed for training classers. The second annual congress was again held during May, at which representatives of wool growers' associations, the trade, and the Department were present. The movement had progressed to such an extent that congress decided to appoint a temporary executive committee and its own secretary.

With the reorganization of the Chemistry Division, it is hoped that the long-needed proper survey of the land which comes under irrigation will be commenced. The lecturer in ostriches is still seconded for work at Wembley for the whole period of the Exhibition, while the Vice-Principal has been seconded to Wembley since May. This diversion of the officers' duties threw an additional burden on those who remained to undertake the teaching of students, and made the interchange of officers for extension work extremely difficult.

4. *Bathurst Experiment Station.*—Considerable development took place during the year, but for the efficient working of the station the following improvements are essential:—Boundary fence and main road to be made vermin proof and experiment plots fenced off; borehole with windmill and reservoir water to be laid on to various stock camps, and paddocks planted with imported grasses; cattle and sheep dips; completion of stables and shed and manager's house. It is trusted that funds will be provided to commence some of this work during 1925-26. The extension, experiment, and research work performed by the officers of the Station is included in the report dealing with these sections.

5. *Publications.*—Seasonal notes and articles were forwarded for publication in the Department's *Journal.*

6. *Experiments and Investigations.*—A large amount of work was undertaken and a great deal more remains to be done, particularly with regard to the economic aspect of farming, while some of the most important of these experiments are delayed owing to lack of funds. The varied nature of extension work to be performed by all

senior members of the staff is a serious drawback to the systematic development of experiment and research work. The time would appear to be ripe to consider seriously, especially in the major project sections, the appointment of a qualified officer whose first duty will be responsibility for the continuity of the experimental and research work of his section. An account of the work in progress has been furnished from time to time and, with the results of completed experiments, has been published in the *Journal.** They cover a wide range of subjects under the main branches of field husbandry (various crops and grasses); animal industry (sun scalding in pigs); entomology (blow-flies, ticks, etc.); veterinary (castration, etc.); sheep (feeding, branding, marking, kemp, mutton production, etc.); chemistry (manurial trials); botany (Karroo plants, etc.); ostriches (breeding, feeding, etc.); horticulture (manurial, pollination, etc.); poultry (feeding, breeding, etc).

7. *Developments.*—If the building programme for 1925-26 is carried out according to plan, all the educational work will be transferred to the new site, which will greatly facilitate the work. All that will remain on the old site will be the students' quarters and mess.

The number of applications received for the various courses were greatly in excess of those received last year, with the result that a great many had to be refused owing to lack of accommodation.

A length of about 3 miles sheep-proof fencing was erected along the Greyskop road. A scheme was completed in the vlei whereby the old course directing flood-water to the dam was diverted over a new area, thereby preventing sand and silt from being carried into the dam. Two other cuttings were made in the river-bed below the new dam in order to protect the banks from caving in and ultimately damaging the main spring. This scheme is not quite complete, but it is intended to continue with it at an early date. Owing to excessive rains, the roads were badly damaged; some considerable repairs, however, greatly improved them. A further seven reinforced concrete tanks were constructed at or near windmills for stock drinking purposes. The capacity of each tank is 10,000 gallons.

8. *Area under Crops.*

Crop.	Acreage.	Total Yield.	
		Tons.	Cwt.
Oat-hay	70	115	15
Lucerne	150	269	10
Maize	4	—	16
Potatoes	6	5	—
Pumpkins	6	6	—
Salt Bush	12	Established.	

Oats and lucerne gave good yields; the harvesting of these was rendered difficult towards the end of the season by heavy rains, resulting in loss of quality.

* Particulars of investigation work in hand were published in the *Journal*, February, 1925.

The yield of potatoes was very unsatisfactory, the crop suffering from late blight. Pumpkins gave a fair yield, but rotted, a feature very prevalent here.

9. *Live Stock.*—The stud stock on hand as at 30th June, 1925, was:—Horses, Percheron, 33. Cattle: Friesland, 71; Red Polls, 17; Shorthorns, 15; Herefords, 2. Pigs: Large Blacks, 11; Berkshires, 21. Sheep: Wanganella, 325; Tasmanian, 115; Karakul, 57. Angora goats, 139. Poultry, 898; and ostriches, 150.

In addition to the stud sheep mentioned above, a Merino flock of 1,440 ewes and 756 Blackhead Persians are maintained at the Institution. The total number of small stock maintained is 4,398. The inadequate stabling accommodation for horses necessitated the maintenance of a larger number of mules and cross-bred horses, the majority of which have to winter in the open. The suitable centralized stabling accommodation now being provided for the Percheron stud will enable the working of the mares throughout the year, and the present number of half-breds, mules, etc., will be considerably reduced. The Shorthorn herd has been disposed of. The property is now completely vermin-proof, and it is hoped to augment further the Merino flock and slightly reduce the Persian flock. The Karakul flock was reduced to about 40 ewes. This change of policy with regard to the sheep section will necessitate the expenditure of a considerable amount of money on internal fencing.

10. *Annual Sale.*—The annual sale was held in September in conjunction with the Middelburg Show, and realized £685. 18s. 6d. The Shorthorn herd was sold in May at Bloemfontein for £925. Out of hand sales, including Karakul flock, realized £338. 5s. Sales on monthly stock fairs realized £30. 0s. 9d.

11. *Labour,* 1924-25.—The number of labour units employed during the year and the average rate of wage were as follows:—

European Males	5,588	units,	average	5s. 2·28d.
„ Females	500	„	„	5s. 10·5d.
Coloured Males	6,708	„	„	2s. 5·5d.
„ Females	892	„	„	2s. 0·6d.
Native Males	12,412	„	„	2s. 1·8d.
Total	26,100			

12. *General Review.*—The progress reported last year continued during the present year.

The wool growers' associations' movement has increased beyond expectation, with the result that the Institution was unable to cope with the demand for the special sheep and wool course and other short courses in the same subjects. The movement has spread to other Provinces, and considerable development may be expected to take place during the next few years. The decision of the Congress to constitute an executive committee augurs well for the future of the movement. The influence which the formation of wool growers' associations had on the farmers themselves and the trade was strikingly evidenced at the last congress. The movement, as the name indicates, not only has for its object the correct classing of wool, but includes correct breeding, feeding, and management. One

of the most important factors in this direction is undoubtedly vermin-proof fences, and it is gratifying to record the enormous advance made in this direction. In districts where no trace of vermin-proof fences existed last year, fencing is going on at a rate unparalleled in the history of fencing in South Africa. Slow progress has been made in the collection of data in connexion with the irrigation works. The need for this work is fully realized, but lack of staff and funds must of necessity curtail the activities of the Institution. It is hoped that, with the additions to the staff of the soil survey section and its concentration in Pretoria, more systematic work will be done. The breeding work in connexion with ostriches is being continued. Unfortunately, the market has not improved appreciably, and the ostrich farmers' outlook is not very bright. The cattle market has somewhat improved owing to the exceptional season, but it is feared that it will be a long time before the industry will be placed on a satisfactory footing. A commencement has been made with the re-organization of the cattle section. Uniformity crops have now been grown for a sufficient period to permit of a certain portion of the plots being permanently laid down to lucerne for the irrigation experiments. The more important experimental investigation work is being continued and few new experiments were started during the year. The first international egg-laying test inaugurated in South Africa was commenced at Port Elizabeth, birds from England and Australia competing, and the Port Elizabeth Agricultural Society, under whose auspices the test is conducted, is to be congratulated.

The work at the Bathurst Experiment Station is being continued and extended as far as funds will permit. Farmers in the Bathurst and neighbouring districts are beginning to take a real live interest in the work of the Station, which is intended to serve a large area of the coastal belt. As this part enjoys a liberal rainfall, one of the greatest difficulties to contend with as far as field experiments are concerned is removed. Given sufficient funds, the Bathurst Station can be developed into one of the most useful stations in the Union.

(iii) Cedara (Natal) School of Agriculture and Experiment Station.

Principal: JOHN FISHER, B.Sc., N.D.A.

1. *Staff*.—The staff on the 30th June, 1925, consisted of 16 professional and technical officers, 3 clerical and 7 assistants. During the year there was one appointment, especially to deal with the pig industry, and one post was sacrificed to make provision for an assistant stockman. The posts of vice-principal and lecturer in veterinary science still remain to be filled.

2. *School*: (*a*) *Courses of Instruction and Students*.—The courses of instruction during the year comprised the two-year diploma course, Parts I and II, and the special courses in July, which were attended by 160 students.

For the diploma course there were 25 students in residence at the end of June, 1925, compared with 22 in June, 1924, when there

were also 6 practical work students. No accommodation is available for practical work students at the present time. No other special courses were held.

(b) *Examinations.*—Of the 1924 junior students who sat for Part I of the diploma course, 13 were successful and entered Part II. One student failed and did not return. Of the eight senior students who took Part II of the diploma course in 1924, seven obtained the school diploma and one failed.

(c) *Visits.*—The senior students paid visits of inspection to several near-by farm to study water power, farm buildings, etc.; to the abattoirs in Durban to study slaughtering methods and the inspection of meat for human consumption; and to the Estcourt bacon factory and the piggeries at Mooi River.

(d) *Competitions.*—Students competed in the inter-school stock-judging competition held at Johannesburg in September, 1924, and in the buttermaking competition at the Rand Easter show. Several students also competed in the buttermaking competition held in Durban in July, 1924.

(3) *Shows and Exhibits.*—The School exhibit was staged at the Royal Agricultural Society's show in Pietermaritzburg and at the Durban show.

Cattle were exhibited for the first time for several years, the farm passing out of quarantine for East Coast fever in May, 1925. One Reserve Male Championship Ayrshire, one Reserve Male Championship Aberdeen-Angus, and one Female Championship Aberdeen-Angus were secured at Pietermaritzburg. At Durban, one Male Championship Ayrshire, one Male Championship Aberdeen-Angus, and one Female Championship Aberdeen-Angus were awarded to the School exhibits.

4. *Extension Work.*—The Annual Dairy Farmers' Conference and the Annual Poultry Farmers' Conference were held at the School during the year. The total attendance at these two conferences was nearly 600 people. Exhibits in connexion with the dairy farming side of the School's activities and the poultry work were staged, and lectures and demonstrations given.

Inquiries dealt with from farmers by School officers considerably exceeded the 2,000 mark. Some 100 lectures and demonstrations were given, with a total attendance of 4,000 people. Fifty-three shows and over 200 farms, poultry yards, etc., were visited. It is becoming physically impossible for School officers to attend to all the calls which are made upon them.

5. *Experiments and Investigations.*—Whilst the number of students remains more or less stationary, and the extension work and correspondence are decidedly on the up-grade, it is in the sphere of experimental and research work that the greatest amount of labour has been accomplished.

A résumé of the results achieved and the further work in progress was published in the *Journal* for January, 1925, and the main lines only of work will be mentioned here.

(i) *Experiments with Phosphates.*—To solve the question of the right sort of phosphatic fertilizer to apply to the red doleritic soils which form the larger portion of the soils in the School area.

(ii) *Experiments to Demonstrate the Value of Legumes in Rotations.*—These have now continued over ten years, and in the three-year rotation of maize, maize, cowpeas ploughed in, the average increase of maize in the first season after ploughing in cowpeas has been 41 per cent. and in the second season after ploughing in cowpeas 31 per cent. when compared with the controls having maize yearly manured with 250 lb. bone-meal per acre. In the five-year rotation, where the cowpea crop is harvested as hay, the increase in the maize following this crop over control maize each year fertilized with 250 lb. bone-meal has been 57 per cent. These findings over a period of ten years show that it is very sound farming to include a legume such as cowpea in the ordinary practice of maize growing in Natal.

(iii) *Experiments in the Cost of Beef Production.*—These are progressing very favourably and the first report will soon be made.

(iv) *Experiments in the Cost of Bacon Production.*—The first reports were not entirely satisfactory, and various alterations in feeding have been made.

(v) *Experiments in the Production of Early Fat Lambs.*—The experiment is being continued during the coming season.

(vi) *Experiments in Egg Production in the Semi-intensive Poultry-house.*—The test began 1st August, 1924, and ended 31st January, 1925. Number of Utility White Leghorn pullets, Cedara bred, 50; total number of eggs laid, 5,319; value of eggs laid, at 2s. per dozen, £44. 6s. 6d., and at 1s. 6d. per dozen, £33. 4s. 10d.; cost of feeding, £9. 17s. 6d.; profit over cost of feeding on first valuation of eggs, £34. 9s.; average cost to produce one dozen eggs, 5¼d. average number of eggs laid per bird, 106.38; average cost of food per bird, 3s. 11¼d.; profit over cost of food per bird, 13s. 9¼d.

The food, fed from self-feeders, was as follows:—*Dry Mash.*—50 lb. wheaten bran; 25 lb. pollard; 15 lb. lucerne meal; 10 lb. crayferine. *Noon.*—Green food. *Grain Feed.*—Crushed yellow maize only. Grit and oyster shell were always supplied, and the dry mash hoppers were open from 7 a.m. to 1 p.m.

This experiment demonstrates what can be done on any farm with well-bred poultry in the way of egg production. It is being repeated, using 100 Utility White Leghorn pullets.

(vii) *Other experiments* include (*a*) the profitable limits of grain feeding for dairy cows of average production during summer months and winter months; (*b*) the cost of rearing and the relative efficiency of dairy heifers raised on a generous scale of feeding, a practical scale of feeding, and the ordinary farm methods of feeding; (*c*) the cost of producing milk and butter-fat; (*d*) the control of insect pests of the maize crop and wattle bag-worm; (*e*) veld studies; (*f*) maize and potato improvement by selection.

6. *Crops and Live Stock.*—A somewhat reduced acreage was under the plough during the year owing to shortage of draught animals, and it is fortunate that this was so, as the abominable season made it impossible to deal with the crops which were planted. 136 tons of maize silage, 95 tons of hay, and 20 tons of grass silage were made. The root crop, though very late, was good, the chou moellier in particular being excellent. Maize was poor, teff poor, but potatoes were excellent, averaging over 100 bags per acre.

The live stock on hand on the 30th June, 1925, comprised:—Horses, Clydesdale, 9; other, 12; mules, 10; work oxen, 46; Frieslands, pedigree, 26; Frieslands, grade, 36; Ayrshires, pedigree, 52; Aberdeen-Angus, 50; other cattle, 24. Pigs: Large Black sows, 7; Middle White boar, 1; young cross-bred pigs in bacon experiment, 46; young Large Black pigs, 6. Poultry, 372. Sheep: Suffolk rams, 2; Persian ewes, 17; Merino ewes, 31; cross-bred lambs, 45.

The Shorthorn cattle were disposed of in January, 1925, the sale realizing £815. 10s. Five young Ayrshire bulls were also disposed of at the Royal Agricultural Society's sale in June and realized £199. 10s.

The season proved a very trying one, and many farmers complained that the cattle were not milking as well this year as previously. Sheep suffered considerably from blue-tongue, and horse-sickness was fairly prevalent, the two diseases being generally more prevalent during wet seasons. Poultry breeders complained of decreased egg production and greater and heavier moulting in poultry as a result of the very heavy late summer rains.

7. *Seed Maize Growers' Associations.*—Two seed maize growers' associations were formed, one at Bergville, the first to be formed in the Union, and the second at Camperdown. This is certainly a step in the right direction, and farmers and others who desire seed maize, selected under the supervision of a Government officer, will be able to obtain it from these associations. Seed will be pedigreed, and increased returns may be looked for from those who plant it.

8. *Development.*—The space between the two existing Dutch barns was roofed in during the year and resulted in great improvement. The staff houses received attention to prevent leaky roofs and the exteriors of the hostel and education blocks were painted. The No. 2 dipping tank was altered to prevent flood-water gaining entrance to the dip.

9. *General Review.*—The season was one of the wettest on record, the rainfall for the twelve months reaching the high total of 56.86 inches. In one month the rainfall at Umfolozi reached 46 inches in 26 days. Heavy washaways on roads, bridges swept away, and cultivated lands flooded and sodden caused serious losses to many farmers.

The past year again emphasized the need for the farmer to pay attention to several branches of farming where this is possible. Last year's high price of maize forced many pig-farmers to reduce their stocks very seriously and to neglect this important side of their farming operations. With the good prospects which were held out for the maize crop this year the far-seeing farmer would have calculated that maize would be cheap and pigs dear owing to short stocks. This was actually the position, prime baconers being sought for at 8d. per lb. live weight, whilst maize was worth only about 11s. per bag.

Again, the farmer should feed his grain as well as roughage foods to stock on the farm and sell only the concentrated result, whether beef, pork, mutton, or eggs, and thus keep as much soil fertility on the farm as is possible. The need to-day is for better organization of the individual farms, followed by better methods, more efficient fertilizing of lands, better seed, and greater efficiency amongst all classes of live stock maintained on the farm, whether for the production of labour, or of flesh, milk, wool, or other produce.

(iv) Potchefstroom (Transvaal) School of Agriculture and Experiment Station.

Principal: THEO. G. W. REINECKE, B.A., M.Sc. (Agr.).

1. *Staff*.—The staff as at 30th June, 1925, comprised: Professional and technical officers 13; assistants to lecturers, instructors, etc., 14; administrative and clerical, 6; housemaster, matron, assistant matron, and caretaker—total 37.

2. *School*: (*a*) *Students*.—For the diploma course the enrolment as at June, 1925, was: First year, 48; second year, 27; third year, 2; special practical students, 2—total 79. The average age of diploma students was 19.3 years.

The vacational short courses, June to July, 1924, were attended by 412 students.

(*b*) *Examinations*.—Of the twenty-four students who completed their two years' diploma course in December, 1924, twenty-one were successful in gaining their diplomas. One student gained a first class diploma with honours in the three major subjects and twenty obtained second class diplomas.

(*c*) *Educational Tours*.—Second-year students attended the farmers' short course in cotton, tobacco, and citriculture, and visited the Government Tobacco and Cotton Stations, the citrus orchards of Messrs. Lucas and Mackenzie, the works of the United Tobacco Factory, and the warehouses of the Rustenburg Boere Ko-operatiewe Vereniging, all at Rustenburg. Both the Easter and spring Witwatersrand agricultural shows were visited, and at the latter students acted as stewards in all classes. On that occasion a tour of inspection was made of the Johannesburg Municipal abattoirs and its by-products manufacturing works.

(*d*) *Competitions*.—A team of students took part in the inter-school stock-judging competition at the Johannesburg spring show, and were successful, being placed first of the five teams representing the five schools of agriculture. Another team succeeded in winning the inter-school buttermaking competition at the Johannesburg Easter show.

3. *Extension Work*.—Letters written totalled 13,114, approximately 6,788 of which were of an advisory nature in reply to inquiries received from farmers and through the agricultural Press; 141 lectures and demonstrations—exclusive of demonstration train—were given; 503 visits were made to farms for the purpose of giving advice, and 46 judging engagements were undertaken at shows. The demonstration train toured the Western Transvaal in late April and early May and a number of lecturers were supplied. The Institution was responsible again for the South African National exhibits of maize, kaffircorn, and peanuts at the British Empire Exhibition, Wembley. In the Boys' Maize Growing Competition, 1924-25, 650 competitors are participating, 48 of whom are from the Orange Free State. The interest and enthusiasm displayed by the teachers and competitors are far greater than hitherto, and the competition promises to be the most successful yet held. The annual

conference of maize growers was held at this Institution on the 14th April. Some fifty maize growers attended from various parts of the Transvaal and the Orange Free State. The experimental fields of maize were inspected, and in the afternoon several lectures were given. After the conference, representatives engaged in the production of maize seed in the Western Transvaal met and decided to form a seed maize association for the western area.

4. *Publications.*—In addition to the regular submission of monthly notes for the *Journal*, 44 articles were furnished for the *Journal* of the Department and other agricultural papers.

5. *Show Exhibits.*—Exhibits were staged at the Witwatersrand easter show and the Pretoria show, in which posters, graphs, charts, photographs, and material were used to bring home to the public and the farmers visiting the show, certain experimental data and facts in farming of significance to the Transvaal farmer.

6. *Investigational Work.*—In the main, investigations centred on the summer cereals and legumes (including peanuts), their improvement, soil and cultural requirements, and utilization as stock feed. The usual varietal, rotation, and cultivation trials with maize were considered, including investigations into the new method of planting maize by means of Lister planter; the significance, if any, of the present-day show standards of seed maize in the ear; the nature and causes of maize pinking; also the degeneration of seed potatoes. Greenhouse studies of the parasite on maize, kaffircorn, etc., of rooiblom or witchweed were initiated with a view to determine its life-history and parasitism; the improvement of the yields of maize, citrus, cotton, etc., by means of fertilizer and rotation trials; the incidence and control of the many injurious insects in stored grain, especially maize stored in the Railway grain elevators.

Live stock experiments were continued in cross-breeding with sheep and with cattle, and the finishing of the products for market. Also in the value of bone-meal in commercial rations to bacon pigs, dairy cows, Merino sheep, and poultry. Investigations proceed in determining the costs and resultant revenue from a pure-bred dairy herd maintained for the greater part on home-grown feeds produced on dry lands and under irrigation. Similarly, the cost of producing bacon pigs grazed on lucerne and other crops is receiving attention.

Experiments in co-operation with farmers on their farms were undertaken in connexion with maize, broomcorn, summer legumes, potatoes, citrus, sugar-beets, and cotton. The citrus trials consisted of a fertilizer experiment at Nelspruit, and the cotton experiments were confined to cultural trials under irrigation in the Ventersdorp and Potchefstroom Districts. In sugar-beet some seventy-five co-operative trials, followed up by laboratory tests, yielded interesting and valuable data, indicating distinct possibilities for the ultimate establishment of a sugar-beet industry in the Transvaal.

7. *Development.*—A great many minor works were carried out, such as the building of three semi-intensive poultry houses, the erection of a Cipoletti weir and concrete furrow for an experiment on the best system of irrigating lucerne. Stone floors were laid in three bull-boxes. Five new pig-paddocks were completed of about

half an acre in size, cement troughs being built and water laid on. The road on the main drive was relaid with suitable gravel, and a large amount of fencing put into proper repair.

8. *Labour.*—On an average 40 white labourers, 18 natives, and 8 convicts were employed, excluding hostel labour, at an average wage of approximately 4s. 2d. per day for Europeans and 1s. 6d. per day for natives and convicts.

9. *Weather and Crops.*—The year was an exceptionally wet one, the total rainfall over a period of 101 days being 34·60 inches. This greatly interfered with the growth of crops and dislocated farm work very considerably. For weeks it was impossible to get implements on to the lands, consequently a considerable quantity of hay was damaged, whilst weeds grew unchecked and apace. The value and quality of the lucerne and teff hay crops were considerably reduced, and the mangold, pumpkin, and vetch crops entirely ruined.

Four hundred and twenty-one acres were planted with maize, oats, teff, sunflower, etc., and 28 acres levelled for planting with lucerne; 207 tons of lucerne-hay, 38 tons of teff-hay, 152½ tons of oat-hay, 86 tons of sunflower ensilage, and 303 tons of maize ensilage were harvested, and it is expected to reap 800 to 900 bags of maize. Seven acres of rape produced a good crop, and a good stand of rye on 5 acres is now being grazed. Altogether 1,003 acres were ploughed and cross-ploughed; 196 acres were fertilized with guano and superphosphate; 60 acres treated with kraal manure; 560 acres irrigated; 329 acres, chiefly maize crop, cultivated to control weeds; 494 acres were harrowed and 76 acres rolled.

10. *Live Stock.*—On hand at 30th June, 1925: *Cattle*: Frieslands 68; Sussex 49; Africander 57; Ayrshire 1; Hereford 1; Aberdeen-Angus 1; Shorthorn 1; Sussex × Africander 28; other crossbred cattle and oxen 112—total 318. *Sheep*: Merinos 266; Suffolk 28; Persians 58; Crossbreds 100. *Pigs*: Large Black and Berkshires 43. *Horses, etc.*: Clydesdale stallion 1; donkey jack 1; other horses 26; and mules 2. *Poultry*: Fowls 632; ducks 2; and turkeys 10. The season was an exceptionally good one for cattle but poor for sheep. The former attained prime condition in December and January, and entered the winter in high flesh. Worm infestation in sheep was tremendous in spite of regular dosing and preventive licks. Sheep entered the winter in relatively poor condition. Cattle were exhibited at the Pretoria and Johannesburg shows, and several awards were gained in the Sussex, Africander, and Fries class. It was decided not to hold the annual sale at the Institution. Certain selected stock was disposed of at the Johannesbuurg fat stock show in September, and the surplus by special sales held in Potchefstroom during September, 1924, and March, 1925. The prices for Merino flock rams, Fries cows, Sussex and Fries bulls, were very satisfactory, and those for Africander bulls and pigs showed a marked improvement. The total live stock sales, excluding poultry, realized £2,122.

It was possible to raise a large number of chickens and to replenish the Poultry Division with a stock of very fine pullets—ten breeds being represented. Of these pullets, 188 are now being single-tested for egg production, and will form the nucleus of strains of pedigree birds which the Division will be able to supply to the public. The majority of these pullets are putting up very good

records and can hold their own with any strain in South Africa. Four new intensive houses have been erected, each holding approximately 60 birds.

11. *Beginsel Training Farm.*—The staff at the 30th June, 1925, consisted of the superintendent, 3 instructors and matron. The post of housemaster was vacant.

The course of training is essentially a practical one, but, when possible, lectures and demonstrations are also given. The students attended the short courses at Potchefstroom, and 10 visited the Witwatersrand show. The number of students in residence as at 30th June, 1924, was 23; 19 enlisted during the year, 28 left, and 14 were in residence at the end of the year. In the past there was no difficulty in placing with farmers students who had passed through the Institution, but lately the demand has fallen off. This may be a passing phase only.

12. *Pietersburg Sub-Station.*—Experiments similar to those of last year were carried out, with the addition of kaffircorn cultivation trials and mangel variety trials. Insect pests were very severe, especially aphis in the kaffir corn and some of the maize plots. Owing to the very severe attack of boll-worm and continuous dull and cloudy weather, the cotton experiments were quite a failure.

Some 600 inquiries were dealt with, seven lectures to farmers were given, and the station was visited by approximately 200 farmers. A farmers' day was held on the 14th February, 1925, when lectures and demonstrations were given to 70 farmers.

13. *Agricultural Conditions.*—The season 1924-25 was one of the most favourable on record for the maize grower of the Transvaal. The area planted with cotton, kaffircorn, and peanuts in the Transvaal Province was considerably increased. Unfortunately, the cotton crop in certain districts was severely damaged by insects, and the yields and quality of the fibre very adversely affected by cold weather and excessive rain towards the end of the season. The season will long be remembered most unfavourably by producers of hay for the market. High yields of oat-hay were obtained, but of fair quality only, owning to the wet season; in lucerne, losses from the excessive rains were very severe. The market, moreover, for hay crops fluctuated, and was very weak earlier in the season.

Sheep farmers suffered heavy losses from a severe epidemic of bluetongue and heavy infestations of internal parasites in their flocks. The necessity and value of providing sheep with clean, underground water in troughs as a preventive against worm infestation is not fully appreciated, nor is the dosing of sheep against wire-worm undertaken systematically, if at all.

The dairying industry is very slowly forging ahead. Its advancement is of vital importance to the farming industry of this Province.

Pig breeders and feeders have had an excellent year, high prices for baconers, porkers, and larders having ruled throughout. There has been a marked improvement in the quality of bacon pigs produced, which, it is hoped, will continue, so that when the pendulum swings towards lower prices and smaller profits, our bacon will bear comparison with that of other countries.

The 1925 fruit season was the most favourable since 1917.

In the poultry industry steady and very sound progress was made.

(v) Glen (Orange Free State) School of Agriculture and Experiment Station.

Principal: E. PARISH, B.Sc.(Lond.), Dip.Agr.(Cantab.).

1. *Staff*.—The staff on the 30th June, 1925, consisted of the principal, twelve lecturers, one farm manager, nine assistants, four administrative and clerical officers, the housemaster, and matron. The post of vice-principal is still vacant. During the year a lecturer in field husbandry was appointed, and also an officer to take charge of the cost of production of maize investigation. The lecturer in entomology was seconded to locust research work in December, 1924, and since that time the post has been vacant.

The following appointments are urgently required, viz.:—Additional lecturer in dairying, itinerant poultry officer, additional sheep and wool officer, assistant to lecturer in animal husbandry, additional chemical officer, additional clerical assistant. The lecturer in household science was transferred during the year to the staff of the Division of Extension, although her headquarters remained at Glen.

2. *School*: (a) *Courses*.—Courses of instruction during the year comprised two-year diploma course, special course in dairying, short courses during winter vacation, special sheep-shearing and wool-classing short courses at the School and on farms, and two-months' special course in cheese-making.

(b) *Students*.—The number of students on the rolls at the 30th June, 1925, were:—Diploma course, first year 56, second year 11; special course in dairying, 7. A remarkable increase in the number of new students enrolled in January, 1925, is attributed to the giving of lectures in Afrikaans, the increased knowledge of and confidence in the Institution, and the granting of bursaries for teachers. The number of students attending the various short courses was:—Glen 328, on farms 65; total 393. Progress in respect of winter vacation short courses is reflected by the following figures:—1923, 190; 1924, 259; 1925, 407.

A large number of unqualified men continue to be appointed to various creameries and factories each year, notwithstanding that students who have passed through the special course in dairying at Glen have everywhere given utmost satisfaction, and that various large and important creamery organizations have declared their intention of appointing only applicants who possess the Glen certificate or equivalent qualification.

(c) *Medium of Instruction*.—The system initiated in 1924 of giving instruction in a number of the subjects in Afrikaans and in the remainder in English was continued and met with approval.

(d) *Vacation Work in Pruning*.—The arrangement whereby students of the Institution prune trees during the winter vacation for orchard owners was continued successfully, the demand far exceeding the supply.

(e) *Successes of Students.*—One honours, one first class, and eight second class diplomas were awarded in December, 1924. Seven students passed the examination in July, 1924, at the termination of the period of training at the Institution, in the special course in dairying, and six in June, 1925, at the termination of the special course in cheese-making, and are eligible for the final examination in factory dairying and management, which may not be taken until after six months' experience in an approved factory. The championship gold medal in the buttermaking competition at the Witwatersrand show was won for the fourth time in succession by a student attending the special course in dairying.

(f) *Educational Tours.*—These included attendance at the local farmers' association meeting, stock sales and the Central Agricultural Society's show at Bloemfontein, a local commercial poultry plant, a pedigree stock farm, the railway workshops, abattoirs, O.F.S. Mills and Egg Circle Depot, and Forest Department nurseries in Bloemfontein, and the Kaffir River irrigation dam.

3. *Training of Teachers.*—In last year's report reference was made to the lack of support of the arrangement whereby candidates can take the diploma course at this Institution in training for teachers. The support this year is very gratifying; twenty-seven out of the fifty-six students in the first year intend to take up teaching at the completion of the course. This represents an appreciable contribution to the solution of the rural education problem, since during their two years at Glen the candidates will become so thoroughly imbued with agriculture that they will inevitably give that agricultural bias to their instruction so generally desired.

4. *Extension Work.*—During the year 244 lectures and demonstrations were given with an attendance of 12,690, including sixteen lectures with the demonstration train with an attendance of 665; 157 visits were made to farms for the purpose of giving advice, 24 judging engagements were undertaken at shows, and 8,440 poultry and 5,382 sheep were classed by officers of the Institution, the extension work performed by the Lecturer in Household Science not being included.

Farmers' weeks were organized at eighteen centres. This feature is becoming increasingly popular, and requests have now to be deferred owing to the demands on the time of the officers concerned. The policy followed was to give preference to farmers' weeks rather than agricultural shows in connexion with the supply of officers for the respective services.

5. *Publications.*—In addition to the regular submission of monthly notes for the *Journal*, seven articles were furnished for the *Journal* and other publications.

6. *Experimental Work.*—The work previously initiated was continued, and a new area of five acres ploughed up nearer the main buildings to facilitate plant-breeding work with kaffir corn and legumes. Plots of indigenous and exotic grasses were established for demonstration purposes, and a veld improvement experiment laid out. Crossing of Suffolk and Blackheaded Persian sheep for production of fat lambs was commenced, a cost of production of pure-bred and

grade Friesland cattle investigation was initiated, and also an experiment to test the comparative resistance to sun-scald of various breeds of pigs, and a test made of the comparative value of various systems of pig feeding. The economic test commenced previously with 100 White Leghorn hens yielded valuable results and is being continued; the intensive-house investigation was continued and another one commenced. Tests were also made of various materials and combinations of materials and fuels for the manufacture of bricks. Bacteriological investigation in the dairy was continued, both on behalf of factories and creameries and of the Government.

7. *Development.*—With the dual object of instruction and the provision of bricks to be used in construction of minor works, four clamps of bricks were made during an exceptionally wet season at an average cost of £1. 1s. 2d. per 1,000, against the landed price of inferior bricks purchased in Bloemfontein of £2. 5s. per 1,000, a saving of approximately 50 per cent. in cost expenditure. Major works comprise five new houses (not completed) and one house being rebuilt departmentally; while numerous other works were carried out departmentally, including a coal and refuse enclosure, dry-stone wall at toe of dam-wall to prevent slippage; stoppage of soil erosion (limited by lack of funds). Three new houses are urgently required, also isolation stables for sick animals, bull and stallion exercise yards, ram sheds, and accommodation for white labourers.

8. *Farm*: (a) *Labour.*—The average wage per adult farm labourer during the year was:—European, 6s. 9d. per diem; and native males, with rations, 1s., and without rations 1s. 4d., per diem. Owing to the higher wages paid for native labour by the contractor, natives were difficult to obtain at the wage offered. The comparatively small number of Europeans employed was due to lack of accommodation.

(b) *Crops.*—113 morgen of land are under dry-land cultivation and 120 under irrigation, in addition to 9 under orchard, 3½ under experiment, and 18 planted with trees. During the year 2,826 trees were planted of thirteen different kinds, partly as shelter-belts and partly to serve the purpose of demonstration, in addition to 168 fruit trees replanted. The following produce was harvested:—200 tons of hay, including Sudan grass, teff, rye, and a mixture of Sudan grass and cowpeas; 300 tons of silage, including 100 tons of sunflower silage; 769 bags of grain, including oats, teff, sunflower, cowpeas, maize, wheat, and buckwheat; 100 tons of mangolds; and 60 bags of potatoes. Over 100 acres of oats and other crops were also grazed off by sheep and cattle.

(c) *Live Stock*—(i) *Cattle.*—The pure-bred Friesland herd consists of twenty-seven cows, fifteen of which are in the Advanced Registry. The grade Friesland herd consists of twenty-one cows and heifers of breeding age. The total milk produced was 21,533 gallons, with an average daily yield per pure-bred Friesland of 32.73 lb., and per grade of 14.23 lb. The majority of the grades in milk were first-calf heifers. The Africander herd consists of fifteen breeding females.

(ii) *Sheep.*—The Merinos consist of 123 stud ewes, 215 flock ewes, with lambs and rams; 26 Persian ewes are also maintained for cross-breeding demonstrations with Suffolk ram.

(iii) *Horses and Donkeys.*—Percheron stud: There are 9 mares, 4 foals, and 1 stud stallion, with 2 two-year-old stallions for sale. The Catalonian donkey stud consists of 11 mares, 3 foals, and 1 stud jack, with 1 young jack available for sale. Four pure-bred Clydesdale mares are also maintained.

(iv) *Pigs.*—Twelve Large Black sows are maintained for breeding pure-breds and for cross-breeding, and two Middle White sows for experiment purposes.

(v) *Poultry.*—The numbers of birds on hand are:—Fowls, adults, 528; ducks, adults, 6; turkeys, adults, 34; geese, 2; total, 570.

10. *Agricultural Conditions.*—The season has, on the whole, been satisfactory both in respect of the pastoral and agricultural industries. The climate was favourable for crop production, although the continued rains during March and April resulted in loss to the maize, potato, and hay crops. The sudden drop in the price of wool at the end of 1924 took many farmers unawares; nevertheless the interest in sheep farming continues unabated. The outlook for both maize and wool farmers appears to be satisfactory. The number of sequestrations and liquidations of farms during the year showed a gratifying diminution compared with the previous years of deflation and consequent adjustment.

Although pig farming does not yet receive the attention in the Orange Free State that it merits, there are signs of increased interest in this important branch.

11. *General Review.*—The Institution appears to have gained the confidence of farmers of the Province, and now receives satisfactory support, particularly from the Afrikaans-speaking section: the number who entered the diploma course, commencing 1925, was three times that of the two previous years. Farmers, moreover, are ready to accept the teachings of the Institution and eager to make use of the facilities provided.

Progress in respect of organization has been considerable; the number of farmers' associations affiliated to the Orange Free State Agricultural Union during the year increased from 65 to 124.

With the constant demands on the time of the officers for extension service, and with the requirements of the diploma and other courses, investigation work does not receive the attention it merits, and the provision of additional staff is essential. Provision is being made for a maize experiment station at Frankfort. It is also hoped to establish much-needed demonstration plots in various areas and to increase the number of co-operative experiments, since it is only by these means that the Institution can adequately serve the varied requirements of the different parts of the area concerned.

Notwithstanding the very satisfactory support accorded the diploma and short courses, the provision of special courses is very much needed. Parliament has sanctioned funds permitting of a commencement being made in this respect by the holding of a special two to three months' course in sheep and wool, designed to meet the requirements of the numerous young farmers who have not attended and will not attend the two-years general or diploma course, or the special eight-months course in sheep and wool at the Grootfontein School of Agriculture.

No. III (b).—DAIRYING.

Superintendent of Dairying: ED. O. CHALLIS.

1. *Staff.*—Mr. D. J. Retief assumed duty as a dairy inspector on the 1st April last. Having obtained a Government bursary, he studied dairying in America, gaining his B.Sc. and M.Sc. degrees. Acting on advice received from this Division, he made a special study of the manufacture of condensed milk, and the valuable information he was able to obtain should prove of great assistance in the future development of that industry in this country.

Before proceeding overseas this officer had over five years' experience in creamery work and management in the Union, and it is considered that all bursary students should similarly have a thorough preliminary training in South Africa in the particular subject they intend pursuing before proceeding overseas, as this assists them very materially in grasping more thoroughly the subject they have selected to study.

2. *General Position of the Dairy Industry.*—The factory production of butter and cheese in the Union during the year ended 30th June, 1925, was:—Butter 11,952,069 lb. and cheese 5,339,755 lb. The position of the dairy industry, as a whole, certainly showed signs of recuperation, and production all round improved considerably compared with the previous disastrous year. The effects of the severe drought and the locust invasion then experienced were still being felt, however, and had an adverse effect upon production; the more or less poor calvings throughout the country can be directly attributed to these adverse conditions. On this account the generous rains with which the country has since been favoured have not had the full effect; while in many districts the excessive rain and resultant floods, and damage to roads, bridges, and railways, made it impossible for farmers to get their milk and cream away from their farms.

Lack of confidence between the farmer and the creamery is unfortunately still very apparent, and has greatly hampered the progress of the industry. In evidence of this one has merely to glance at the year's butter production by creameries in the Union, amounting to only 11,952,069 lb. Considering the length of the time during which creameries have been established, this total, even allowing for bad seasons, etc., would have been at least double had the creameries received the support they are justly entitled to. The total production of butter in the Union during the year 1921-22 was 21.873,000 lb., and of this quantity 12,508,000 lb. were produced by creameries, leaving a balance of 9,365,000 lb. produced by farmers, or in other words, by individual effort. The Census figures for farm butter for the period under review were not available, but there was no sign that the production of farm butter had decreased. This is a most unsatisfactory state of affairs, and no industry can possibly expect to flourish or make progress under such conditions. Drastic steps will have to be taken to restore confidence between the various creameries and cream suppliers, and it is considered that, as a first step towards achieving this object, a commission of inquiry should be appointed for the purpose of making an exhaustive examination into the present

position of the dairy industry and ascertaining, if possible, the main reasons for the lack of confidence which is so apparent on the part of the farming community throughout the Union.

The Division has given the present position of the dairy industry very serious consideration, and every effort has been made to bring about an improved state of affairs. To this end the work of grading and testing of cream by creameries was constantly inspected and checked. Large numbers of samples of cream were taken from consignments en route to the creameries and the results compared with those given by the creameries concerned; where any but negligible differences were found, such action as the circumstances appeared to warrant was taken. There is no doubt that this work had a beneficial effect, and a consistent continuance of it should prove very useful in helping to restore the much-needed confidence between creameries and cream suppliers.

It is further considered that if dairy farmers throughout the Union grasped more thoroughly the true purpose of co-operation much good would result, for if they are dissatisfied with existing concerns, why do they not form themselves into co-operate bodies under the Co-operative Act? Every shareholder under that Act must be a supplier, and so long as he remains a member is bound to send all his milk or cream to the co-operative body which he joins. The adoption of some action of this kind is suggested as an alternative to the continued tendency of farmers to work on individual lines which, if persisted in, will ruin the whole of the dairy industry of this country. If the creameries in the Union were obliged to close down owing to lack of support it would be the producers of farm butter who would suffer, and most probably the larger portion of the farm butter produced during the summer months would realize less than 8d. per lb., while during the scarce season the country would be flooded with the imported article. To prevent such a disaster every effort must be made to place the industry on a sound and satisfactory basis.

3. *The Cheese-making Industry.*—The cheese-making industry generally is in a fairly satisfactory position, although the year's output of cheese was only 5,339,755 lb., a decrease of 138,491 lb. on the production of 1924. The excessive rains had no doubt a good deal to do with the decreased production, and most decidedly had a deleterious effect on a good percentage of the cheese produced. From investigations made, dirty milk was found to be the root of all the trouble, and it is incumbent upon suppliers of milk to cheese factories to adopt more hygienic methods and produce cleaner milk. It is quite impossible for the most skilful cheesemakers to manufacture a nice, clean-flavoured cheese if, due to the careless methods of a large number of milk suppliers, they are constantly supplied with tainted milk. It is very satisfactory to note that greater advantage has been taken of the facilities offered for grading cheese for local consumption. The total quantity graded amounted to 3,593,551 lb., which produced £1,871. 12s. 10d. in fees. This shows an increase of 1,969,129 lb. over the previous corresponding period, and an increase in grading fees of £1,025. 11s. 9d. Out of a total of 139 cheese factories now operating, 75 are having their cheese graded for local consumption, and the two official graders have been kept extremely busy keeping pace with the extra demand made on their services.

4. *The Year's Work.*—Apart from the special work carried out in connexion with cream testing and grading already referred to, the staff was continuously engaged in the administration of the Dairy Industry Act, the strict application of which is becoming increasingly necessary. Control of the manufacture of butter substitutes required a great deal of attention, and a number of prosecutions—most of them successful—resulted. Increasing advantage was taken of the services of officers of this Division and demands were more numerous than ever. Advice was sought in all directions—from the making of farm butter to the establishment and equipment of creameries and cheese factories. Correspondence increased very considerably, calling for a great deal of attention. Officers attended and gave lectures at a large number of farmers' association meetings and "farmers' weeks," and in addition addressed numerous special meetings called for the purpose of discussing the establishment of co-operative creameries and cheese factories, as well as other matters connected with the industry, such as the formation of cow clubs, milk-recording, etc. A great deal of what might be described as development work, particularly in the northern Transvaal, has also been accomplished and advice given to settlers and others. One officer was in charge of the dairy coach on each of the trips made by the demonstration train, and a great deal of useful advice was circulated in this way amongst the farming community. A certain amount of investigation work was undertaken in conjunction with the dairy section of the Glen School of Agriculture, and the cause of abnormal and undesirable flavours in cheese manufactured in the Districts of Wodehouse and Aliwal North, Cape Province; Standerton, Transvaal; and Alfred, Natal, was investigated, also the cause of undesirable taints which develop in butter made from cream produced in the neighbourhood of Springfontein. In some cases the results obtained enabled the Division to overcome the trouble, but in others the investigations are not yet complete. There is no doubt that, if full advantage is to be secured from investigation work of this nature, a whole-time research officer must be attached to this Division, for, where an officer has duties to perform in addition to research work, many highly necessary and essential investigations have to be kept in a more or less inconclusive state, and the real benefits to be derived from research work are in a great measure nullified.

Summary of Staff Activities: (a) *Grading for Export.*—Butter, 7,383 cases graded, producing £92. 5s. 9d.; cheese, 1,803 crates graded, producing £15 0s. 6d. Total revenue £107. 6s. 3d.

(b) *Administration of the Dairy Industry Act*—(i) *Prosecutions.*—Nine, of which six were successful and three unsuccessful; two other prosecutions were conducted in conjunction with municipalities, both of which were successful.

(ii) *Samples Taken and Analysed under the Dairy Act.*—Creamery butter, 284; farm butter, 95; butter substitutes, 47; other dairy produce, 96; total, 532. Of this total, ten samples failed to comply with the Act, and prosecutions followed in most cases.

(iii) *Visits of Inspectors to Creameries, Cheese Factories, and other Premises under the Act.*—826.

(iv) *Candidates Examined for Certificates in Cream Testing and Grading.*—Testing: 18 examined; 15 passed; 3 failed. Grading: 32 examined; 28 passed; 4 failed.

(v) *Samples of Cream taken up to 31st March, 1925, for purpose of Checking Creamery Tests and Grading.*—En route to creameries: 335 tested; 80 graded. At creameries: 457 tested; 105 graded.

(c) *Other Activities.*—(i) Farmers' meetings and weeks attended, 110. (ii) Agricultural shows attended and judged at, 36.

(d) *Number of Premises Registered under Dairy Act at 31st March,* 1925.—Creameries, 74; cheese factories, 139; cream depots, 52; butter substitute factories, 22; condensed milk factories, 1; margarine factories, 1.

5. *Government Milk-recording Scheme.*—The position of the milk-recording scheme was more satisfactory; the number of cows in test at the close of the year showed an increase on the previous year, although this is not a true reflection of the position, as practically every month new farmers join and others temporarily drop out. Everything, however, pointed to a much greater interest being taken in the scheme, and, with every indication of next season being an early one with good calving prospects, it is anticipated that a far larger number of herds will soon be in test. Further, if this anticipated increase actually materializes to any appreciable extent, it will naturally necessitate the appointment of more recorders. In this connexion it is considered that it would be advisable to appoint a senior recorder, whose duty would be to inspect the work of all recorders in the Union, address farmers' meetings on the advantages of milk recording, and, whenever necessity arises, to act as a relieving recorder. Such an appointment, when warranted, would prove of great advantage, as, apart from any propaganda work which this officer would be able to carry out, it is highly desirable that milk recorders generally should be under some system of inspection, as at present they are working more or less as free lances. For instance, during the last six months two recorders left the service, and it was not until some time later that serious irregularities were revealed. When men are still in the service the average farmer hesitates to lodge a complaint. These unfortunate occurrences would seldom happen if recorders were under stricter supervision.

Another point which should receive consideration is the advisability of reducing the present fees charged for recording work. Milk recording in this country is only in its infancy, and if the dairy industry is to make any appreciable progress, greatly enhanced production and the improvement of our grade dairy herds are the first steps to bring it about. It is a recognized principle in most progressive countries that milk-recording schemes cannot be made to pay without charging prohibitive fees, but the necessity for establishing milk records in every dairying country is universally recognized, and if it does become necessary annually to subsidize such schemes it will be money well spent. One of the greatest deterrents in South Africa to a general adoption of milk recording is the annual cost to the farmer, and it is confidently asserted that if the present scale of charges were materially reduced much good would result and milk recording would become general. In addition to assisting milk recording, every endeavour should be made and assistance given to induce farmers to use a better class of bull. It is appalling to see the number of "scrub" bulls still being used in the Union, and an enormous amount of propaganda work is essential, not only to eliminate the "scrub" bull, but to drive home to the dairy farmer the

absolute importance of using pure-bred bulls which have good milk records behind them. During 1924, 59 herds were tested, with a total of approximately 500 cows. During June, 1925, 83 herds were in test, with a total of approximately 700 cows. The total revenue amounted to £1,548. 4s. 6d., which shows an increase over the previous period of £321. 14s.

No. III (c).—TOBACCO AND COTTON.

Acting Chief of Division: PIETER KOCH, B.SC.AGR.

1. *Administration*.—The Division deals with the main problems of the tobacco and cotton industries in the Union, the purpose being to increase the prosperity of the farming public by the aid of research and extension. Its aim is to find the most economical means of producing high grade tobacco and cotton, and to produce more with less human effort. To accomplish this, the extension work must be replenished from the research work conducted at the Division's three experiment stations at Rustenburg, Elsenburg, and Barberton.

The work of the Division is still handicapped through lack of additional research and extension officers. The few research officers have all too often to neglect their work and give itinerant instruction in order to cope, to some extent, with the heavy demands for their services from the farming community. The rapid development of the cotton industry, and the increasing demand for the better types of tobacco, especially cigarette tobacco, necessitate an increase in the field staff, otherwise we shall be compelled to continue to notify farmers that it is impossible to meet their requests. The agricultural schools, the universities, and the Extension Division also make very heavy demands on us, which become increasingly difficult to meet. As the officers of the Tobacco and Cotton Division apparently have a commercial value greater than that of other Divisions, they are continually being offered tempting positions outside the Service, with the result that, of the 1913 staff, which was larger than the present one, only the Acting Chief is left; one has rejoined, and several have since been appointed but have also resigned for better positions. The wastage through men leaving to take up better positions is exceptionally great. The Department realizes this and active steps are being taken to counteract it. More ought to be done, however, not only to fill the vacancies thus created, but to increase the staff.

2. *Staff*.—During the year, Mr. E. H. T. Powell was appointed as itinerant instructor for Natal and Zululand, *vice* Mr. C. L. White, resigned, and Mr. J. L. Henning was appointed at Rustenburg, *vice* Mr. P. Koch, transferred to Pretoria to take the place of

Mr. W. H. Scherffius, who is on long leave prior to retirement. Mr. Th. G. Hesse, Senior Cotton Grader, resigned, and Mr. C. J. Homewood was promoted to the senior post. Mr. H. R. Halbert, manager, Piet Retief station, resigned.

3. *Publications.*—Four articles were published in the *Journal* of the Department, and a number of articles and reports were prepared by the various members of the staff for the agricultural Press and prospective tobacco and cotton growers. The usual reviews of the cotton crop were compiled and published.

4. *Tobacco.*—The 1923-24 tobacco crop showed a decline. The production was approximately 11,750,000 lb. The spring of 1923 started very dry, and it was difficult to obtain good stands; in many cases the lands had to be replanted three times. During the curing season again, continuous rains caused a large percentage of dark and low-grade leaf. The present crop (1924-25), although having suffered from heavy rains, is of a better quality. On the whole, the prices for the better grades remained fairly steady. The demand for tobacco suitable for cigarette manufacture cannot be fully met; every effort is, however, being made to meet it. The Turkish tobacco crop suffered heavily from damage by tobacco wild-fire and owing to this the quality was not up to the usual standard. In view of the spread of this bacterial disease of tobacco, a pathologist was specially appointed to the Division of Botany in order to go into the problem scientifically. The Tobacco and Cotton Division continued to clean, grade, and disinfect tobacco seed for farmers. The co-operative societies were able to dispose of most of their tobacco stocks at reasonable prices.

5. *Cotton.*—The cotton crop for 1923-24 amounted to 3,492,065 lb. of lint, an increase of 33.8 per cent. over that of the previous season. Owing to drought and locusts, the crop in the western Transvaal was practically a total failure, otherwise the increase would have been very great. The 1924-25 crop, on the other hand, suffered heavily from floods, washaways, and insect attacks, but in spite of these it will be more than double that of the previous season. With the phenomenal interest in cotton culture, large stretches of ground are being cleared and prepared for the 1925-26 crop. If anything like a favourable season is experienced, a production of more than 15,000,000 lb. of lint, or 30,000 bales of 500 lb. lint each, may be anticipated.

The demand for cotton is increasing at a faster rate than the supply, and with prices ranging from 12d. to 15d. per lb. the interest in cotton culture will not only be maintained, but intensified. Millions of acres of suitable cotton land in the Union are at present lying idle and are only awaiting capital for their development. The only serious obstacle is the alarming increase of insects, particularly the boll-worm. At present two young entomologists, seconded by the Empire Cotton Growing Corporation, and one senior entomologist of the Department, are engaged on the study of cotton insects.

6. *The Empire Cotton Growing Corporation.*—The Empire Cotton Growing Corporation has seconded Messrs. Milligan and Parnell for service in the Union, the former as administrative head to the Corporation, and the latter as plant breeder for the low veld,

with headquarters at Barberton. Although Mr. Parnell has been at Barberton for one season only, he has accumulated very useful information with regard to the resistance of some types of cotton against the attacks of the jassid insect. The work has for some years engaged the attention of Mr. Lloyd Worrall, the senior cotton expert of the Department, and the research work thus accomplished constitutes a good sound foundation on which Mr. Parnell can build. In addition to these two officials, the Corporation has lent to the Union Department the services of two entomologists and a soil chemist. Furthermore, through representations made by Mr. Milligan to his Corporation, two senior and two junior scholarships of a total value of £1,000, plus all travelling expenses, have been granted to the Department. The two seniors have been selected from the junior staff of the Tobacco and Cotton Division, and are taking an advanced course in cotton research at the Imperial College of Tropical Agriculture, Trinidad. On their return they will again join the Union Department. The Union Government fully appreciates the action of the Corporation, and the great interest it is taking in the tremendous possibilities of cotton growing in South Africa. The relations between the Department and the Corporation officials are of the happiest.

7. *Pure Seed.*—The selection and breeding work which had been in progress at the Rustenburg Experimental Farm for the last four years is progressing rapidly. Mr. A. R. Pullen, the cotton breeder, is giving all his attention to solving the problem for the middle veld. One hundred acres have been planted by him to commercially pure seed of cotton, and approximately thirteen tons of seed will be available for distribution for the 1925-26 crop. Only a few careful cotton growers are being selected as multipliers of this seed, and the growing of the crop and the subsequent distribution of the resultant seed are to be under the control of the Chief of the Tobacco and Cotton Division. Steps have already been taken to put this in operation during the coming season. This will go far to finally solving the pure seed problem for the large middle veld cotton-growing areas.

8. *Cotton Fertilizers Experiments.*—Mr. S. Milligan, representative of the Empire Cotton Growing Corporation, realized the importance of the fertilizer experiments that had been conducted since 1909 by the Division's experiment stations at Rustenburg, Barberton, Tzaneen, and Piet Retief. (The Tzaneen and Piet Retief stations have since been closed down.) As these experiments had been designed to cover both tobacco and cotton, he suggested that the results achieved might with advantage be modified to apply to cotton as the main crop and carried out by a number of selected cotton growers under the supervision of the staff of the Division. Although the many previous experiments carried out by the Division in co-operation with farmers were far from satisfactory, owing to lack of staff and dislocation created by the War, a meeting was called to discuss the matter and to discover if it would not be possible to commence another series of experiments on similar, though modified lines. As a result, it was decided that eighteen series of plots should be laid out throughout the cotton belt.

As this work will entail a great deal of attention, the staff is to be augmented by an additional officer, and the Corporation has

promised a field officer, the latter to take charge of the three series of plots to be laid out in the Ngotshe area bordering on Zululand and Swaziland. The agronomists and chemists of the agricultural schools will also take charge of several experiments. But for the assistance to be rendered by the agricultural schools and the Corporation official, this work could not be carried out to the same extent. These experiments are to be continued for a period of four or five years, and are likely to be extended for a further period cf years. The Corporation very kindly seconded an official for the chemical and soil investigations which have to be undertaken in connexion with this work.

9. *Agricultural Shows.*—The officers of the Division had a busy season judging at various agricultural shows. An excellent display of tobacco and cotton was staged on the Johannesburg, Pretoria, Pietermaritzburg, Rustenburg, and Durban shows, the Division's exhibit being considered one of the chief attractions.

10. *Experiment Station Work.*—Experiments were continued on fertilizer and crop rotations, curing of tobacco, comparative tests of different varieties of tobacco and cotton, testing different distances in the row for cotton, comparative tests with selected strains of cotton in row and plot trials, and irrigation experiments in connexion with cotton. Selection and breeding were continued.

At the Rustenburg Experiment Station the acreage under selected strains of cotton was increased from forty to one hundred. The students hostel had its full quota, with about sixty names on the waiting list. The demand for training is so great that a sum of £9,000 was set down for the enlargement of the hostel and offices. The new hostel, the offices, and laboratories are now in course of erection, and will be ready for occupation at the end of the year.

During the year, 722 people visited the Rustenburg Station, which is open for inspection at all times. The Elsenburg Tobacco Station was visited by 140 people. The Piet Retief station was closed down during the latter part of the year.

The Rustenburg Station supplied the major portion of the tobacco seed required by the growers of Virginian tobacco. The Elsenburg Tobacco Station still supplies practically all the selected tobacco seed required in the Turkish tobacco growing areas. "Many Leaf Soulook," the strain of tobacco which originated at this station, continues to be the favourite, fully 95 per cent. of the growers preferring it to anything else.

11. *Grading Cotton.*—Excellent cotton-grading offices were erected at Durban and were occupied by the senior cotton grader early in the grading season. This, together with the timely appointment of a temporary grading assistant, enabled him to cope effectively with the rush of work. The adoption by the Department of a rigid system of grading cotton under regulation contributes largely to the excellent reputation South African cotton enjoys overseas. Under the system every bale of cotton must be graded, and a certificate of quality issued in respect of it. No other cotton-growing country has a better system of grading and baling in vogue than the Union. Last season, 7,270 bales of lint were dealt with by the Government grader, who also had a large number of samples of seed cotton sent to him to report upon.

12. *Itinerant Work.*—The itinerant staff in the eastern Transvaal, Orange Free State, Natal, and eastern and western districts of the Cape Province were hard pressed to meet the many requests for their services. They were fully occupied with itinerant work, judging at shows, and delivering lectures at the agricultural schools, the universities, special short courses, and at farmers' meetings.

13. *Central Co-operative Cotton Exchange.*—The following eleven societies are now affiliated to the Central Co-operative Cotton Exchange: The Rustenburg Boeren Koöperatieve Vereniging; the Rustenburg Co-operative Cotton Company, Ltd.; the S.A. Co-operative Cotton Growers, Ltd., Durban; the Swaziland Co-operative Cotton Growers, Ltd.; the Zululand Co-operative Cotton Company, Ltd.; the Lydenburg Koöperatieve Landbouw Vereniging; the Barberton Cotton Co-operative Company, Ltd.; the Pietersburg Ko-operatieve Landbouw Vereniging; the Waterberg Landbouwers Ko-operatieve Vereniging; the Northern Rhodesia Co-operative Ginneries, Ltd.; the Griqualand West Cotton Growers' Co-operative Society, Ltd.

No. III (d).—HORTICULTURE.

Chief of Division: I. TRIBOLET.

1. *Administration.*—The Division has been augmented by the arrival of Dr. F. de Villiers and Dr. Redvers Blatt from California. These officers will prove of great value to the hitherto poorly staffed Division. Dr. De Villiers is to specialize in the matter of pollination of deciduous fruits in the western Cape Province. His headquarters will be for some time at Elsenburg. During the grape season he carried out some investigations into the breaking down of our export varieties of grapes.

Dr. Blatt has been very busy since his arrival in improving our citrus groves through selection and propagation of the best available types of the different varieties of citrus fruits grown in the country; to this end, he has been touring the citrus areas, judging at shows, conducting the horticultural sections at short courses, and doing a certain amount of advisory work as he goes about. The staff remains practically the same as it was last season, with the exception of the additions mentioned above.

The Chief of the Division carried on the ordinary routine work connected with the administration of this section; judged at most of the shows, gave lectures and demonstrations wherever possible, attended to correspondence, visited the ports where inspection is carried out, and attended conferences, etc.

2. *Inspection of Export Fruit.*—This was proceeded with as usual at Cape Town, Mossel Bay, Port Elizabeth, East London, and Durban. Inland inspection was also carried out at Rustenburg, Zeerust, Koster, and Woodbine.

3. *Export of Citrus Fruit.*—Owing to the rapid increase in the export of citrus fruit and the unfavourable weather early in the season, which increased the percentage of wastage in fruit arriving at the ports, it was deemed advisable to institute a repacking station at Cape Town, under the auspices of the Fruit Growers' Co-operative Exchange, and many consignments rejected by the fruit inspectors were repacked, reinspected, and eventually shipped overseas. Whilst proving a great boon and saving to the growers directly interested, it is hoped that in normal seasons this institution will be found unnecessary, especially when central packing-houses, which in the near future must be established in the various citrus areas, are in operation. Without doubt the double handling, however carefully done, has a detrimental effect on the travelling and keeping qualities of the fruit.

4. *Export of Deciduous Fruits from the Transvaal.*—During the season a certain amount of deciduous fruit from the Transvaal was exported oversea. Although two or three growers exported previously to this, it may be said that the past season initiates what may become, with careful handling, a trade of some magnitude and of considerable benefit to those concerned. It has been fairly well demonstrated, assuming pre-cooling and a supply of refrigerated or iced trucks for the journey to the ports, that various types of deciduous fruits may be successfully shipped overseas from the Transvaal at a time somewhat earlier than from the Cape Province, which in the past has held what might be termed a monopoly of this particular trade. The Transvaal fruits have the advantage of entering the overseas markets when practically bare of deciduous fruits, and they interfere but little with the trade of the Cape Province. The Transvaal and the Orange Free State have to a certain extent been producing of late a surplus, after meeting local demands. If fruit growing is to remain a commercial proposition in these Provinces the matter of export will have to be seriously considered.

5. *Dr. Webber's Visit.*—Mention may here be made of the distinguished horticulturist, Dr. H. J. Webber, who paid a visit to the Union and Rhodesia, and whose informative and exhaustive report on our citrus fruits, and conditions under which they are grown, will be read, it is trusted, with interest and benefit by every grower in the Union.

The following statements show the quantities of fruit, fresh and dried, exported from the Union during the twelve months ended 30th June, 1925:—

(1) FRESH FRUIT EXPORTED (PACKAGES).

1st July, 1924 to 30th June, 1925.

Fruit.	July, 1924.	August, 1924.	Sept., 1924.	October, 1924.	Nov., 1924.	Dec., 1924	January, 1925.	Feb., 1925.	March, 1925.	April, 1925.	May, 1925.	June, 1925.	Total (Packages).
Oranges	184,270	83,246	42,298	41,487	723	—				7	1,932	10,279	364,242
Naartjes	22,415	12,018	4,070	1,048	67					5	2,558	26,711	68,892
Grape Fruit	6,521	1,972	59		—				—		—	8,499	17,051
Shaddock	8	—	—		—					—	—	—	8
Lemons	—	4	7						—		14	—	25
Pineapples	8,380	7,450	1,923	592	102	186	3,097	5,613	2,368	4,443	12,008	22,302	68,464
Granadillas	41	1	—		75	628	343	66	4	—	16	—	1,174
Papaws	—	4	—		—	—	—	—	—	—	—	—	4
Peaches	—	—	—		128	24,463	71,643	105,769	3,849	754	476		207,082
Plums	—	—	—		68	15,337	59,045	44,165	18,644	423	10	—	137,692
Apricots	—	—	—		2,437	11,405	1,097	—	—	—	—	—	14,939
Pears	—	—	—			87	77,620	276,784	191,421	212,424	37,910	—	796,246
Apples	—	—					—	37	1,116	1,134	652	99	3,038
Grapes	—	—	—		—		4,194	56,051	131,047	84,021	28,886	8	304,207
Nectarines	—	—	—		—		15,743	13,639	698	—	—	—	30,080
Melons	—	—	—		—		9	155	268	79	10	8	529
Cherries	—	—	—		37	203	—	—			—	—	240
Tomatoes	—	—	—			7	28	5	—		50	—	90
Mangoes	—	—	—	—			804	612	69	—	—		1,485
Avocadoes	—	—	—				—	32		48	50		130
Quinces	—	—	—							—	187		187
Persimmons	—	—	—							50	—		50
Pomegranates	—	—	—							8	—	—	8
	221,635	104,695	48,357	43,127	3,637	52,316	233,623	502,928	349,494	303,396	84,759	67,906	2,015,863

(2) DRIED FRUIT EXPORTED (PACKAGES).

1st *July*, 1924 *to* 30*th June*, 1925.

Month.	Apricots.	Sultanas.	Raisins.	Prunes.	Peaches.	Pears.	Figs.	Currants.	Dried Grapes.	Melons.	Apples.	Assorted.	Almonds and Walnuts.
1924.													
July	250	10,727	25,260	—	388	36	—	—	5,000	—	—	—	—
August	143	3,957	15,161	123	308	2	5	3	17,244	—	—	—	—
September ...	544	4,358	2,043	853	90	—	8	6	3,000	—	—	—	—
October... ...	82	1.868	258	76	273	18	2	34	2,444	—	5	—	—
November ...	36	482	—	2	51	780	—	—	1.704	—	—	—	—
December ...	234	70	10	230	17	—	—	5	—	—	50	—	—
1925.													
January ...	4,444	6	11	23	—	—		—	—	—	5	—	—
February ...	8,278	203	3	6	—		—	5	—	—	—	—	—
March	5,575	3.186	13,406	1,014	2,721	3	—	7	—	—	5	—	—
April	3,420	2.881	11,678	210	560	—	—	1	—	—	7	452	—
May	2,007	11,575	32,572	4,446	2.859	10	10	—	110	—	30	355	—
June	1,364	15,818	26,510	10.480	410	1.004	—	—	121	2	12	264	13 bags
	26.377	55,131	126.912	17.463	7,677	1,853	25	61	29,623	2	114	1,071	13 bags

Total ... ... 266.322 packages.

(3) TONNAGE: The number of packages exported as per the foregoing statements comprise the following tonnage:

Fresh fruit	51.646 tons.
Dried fruit	4.200 tons.
	55,846 tons.

No. III (e).—VITICULTURE.

(i) *Government Viticulturist:* S. W. VAN NIEKERK.

1. *Experimental Work.*—The duties performed by this section of the Department are of an advisory and experimental nature. Farms are visited by request and meetings addressed on viticultural matters. Information is also given through correspondence. Experiments are carried out in vineyard cultivation, wine-making, American stocks, etc.

Thirty experimental American stock plots are conducted in co-operation with farmers in the most important viticultural districts. These experiments are valuable in advising growers which American stocks to use in the different districts. A full report on these plots is being compiled.

To stimulate and improve the production of raisins and sultanas, experiments in raisin-making were arranged in co-operation with farmers in the Worcester District during the 1925 season.

Experiments were carried out at the Paarl Viticultural Station during the 1925 vintage with regard to the packing of grapes for export, to determine whether the methods of handling grapes now in vogue are the most economical and satisfactory for trade demands. The following were the points aimed at:—

To determine (*a*) the most economical and efficient pack; (*b*) the wilting period prior to packing; and (*c*) the best period during the day for harvesting grapes. At the same time investigation was carried out in the laboratory to study the anatomy, the enzymes, the respiration, the transpiration, and the factors affecting the keeping quality of grapes. A full report on the experiment is being compiled.

2. *Paarl Viticultural Station.*—At this station different varieties of grapes are grown, tested, and reported upon. From time to time new varieties are imported, while even from local varieties selections are made and tried out to find the best export, raisin, and wine-making grape. During the past year three new varieties were introduced for raisin-making and two for export. Two new varieties of American stock were imported, and ten different selections made from local stocks.

The wine made at the station is of good quality, and the prices obtained satisfactory.

The importance of the station is increasingly recognized by the public, and many people visit it during the season to inspect the different varieties of grapes and to obtain other information. This season no fewer than 111 different varieties were distributed all over the Union.

Practically all the soil at the Paarl Station has been utilized for vines, consequently a certain amount of the experimental work has to be conducted at Elsenburg, where a series of manurial experimental plots has been established.

3. *Export of Wine.*—In the Oenological Institute at Elsenburg wines for export were tested. 111 samples of wines were sent for analysis with a view to obtaining a certificate for export; four were turned down and 107 received certificates. Everything possible has

been done to establish an export wine trade to Europe, and by means of assistance and advice rendered them farmers exported direct during the year 32,162 gallons of wine, valued at £2,770, an average of almost £11 per leaguer. Very few other wines were sent for analysis by farmers on account of the high fees charged for an ordinary analysis. This class of wine, therefore, has practically stopped coming in, which is unfortunate, as, apart from the information required by the farmer, much investigation could be done on such wines.

4. *Laboratory Work.*—The laboratory work consisted of chemical and bacteriological investigations, the former including research on the following subjects:—

(*a*) The acid contents of dry wines and, in this connexion, the phenomenon known as "casse" of wines; (*b*) the complete analysis of two wines, one of 1924 and one of 1925, to ascertain whether Malo-Lactic fermentation takes place in South African wines and, if so, its relation to the stability of our light dry wines; (*c*) the sampling of vinegar to test the strength.

In regard to bacteriological investigations, it had been observed last year that sweet wines were infested with bacteria. It has since been noticed that dry red wines are particularly affected by this disease, which causes wine which might otherwise become excellent to acquire a bitter taste and in a very short time to become quite unpotable. The volatile acidity of these wines is excessively high, thus causing them to be useless for anything but distillation, and the production of a brandy of inferior quality. Investigation is proceeding with a view to isolating the organism causing the trouble.

Last year, owing to the small demand for pure yeasts, none was prepared. It was thought, however, that farmers might want to try the use of levures, and pure cultures were again got ready. The demand for these was most disappointing, only a small quantity being sent out.

Fermentation experiments were carried out to determine the effect of tannin, SO_2 (sulphur dioxide), and acidity on the resulting wine, and similar experiments with sweet wines to find the best time to add the spirits for fortification, and in what proportion.

5. *General.*—During the year a short course in wine-making of a week's duration was given at Elsenburg; also a three days' wine course at Montagu and a similar one at Worcester. In the latter town especially this course was very successful, the average attendance being 75 farmers. It is hoped that in future similar courses will be given in other centres.

Eighteen farmers' meetings and 6 shows were attended and 120 farms visited, advice being given on viticultural matters.

In many instances the deterioration of vines is due to the use of the wrong stock on certain soils. The Aramon stock is certainly giving much trouble. A couple of years back it seemed to be chiefly in the Helderberg area of Stellenbosch, but lately it is found in practically every wine growing district. Cryptogamic diseases were exceptionally bad last year, especially anthracnose, as, during the early part of the summer, weather conditions were very favourable for its development.

The vintage was a fair one, although it varied very much in different areas: in some it was below normal, in others normal, and in parts above the average. It is calculated that about 113,000 tons of grapes were turned into wine and about 20,000 tons into raisins. Prices of good wine varied from £5 to £8 per leaguer. Local merchants bought up practically the whole crop.

From the above it seems that a tremendous stimulus has been given to viticulture, a fact which is further evidenced by the prices paid for grafted vines. For instance, for Hermitage and Hanepoot £10-£15 was paid per 1,000 during the latter part of the season, and many intending planters could not obtain any. During the previous season many vines were sold late in the season at £3 per 1,000 The demand for stocks, too, was very heavy, and prices in some instances almost as high as when phylloxera started to destroy our vineyards. It is, of course, hoped also that, with preference, a bigger trade will result with England in raisins and wines. The export of grapes was, on the whole, not too great a financial success; this is probably the reason why the demand for export varieties was nothing more than usual.

(ii) *Government Wine Farm, Constantia.*

Manager: A. G. VAN RENEN.

1. *Apprentices.*—During the year a portion only of the full number of apprentices were in residence. Owing to the decision to close down the farm, the number has gradually decreased as the boys obtained other employment; the number engaged at the close of the financial year was 11. The Department gave the apprentices the opportunity of going to the Beginsel training farm for twelve months, but none of them appeared to be keen on going as the training there would not be suited to those who particularly wish to farm with fruit and vines. The behaviour of those in residence during the year was excellent; the boys lately engaged are of a superior type to many who have been here in the past, and they have consequently taken a greater interest in their work.

2. *Vintage.*—The vintage was an average one; the young vines planted out during the past three years are now beginning to bear fruit, so that the next and following vintages will show a greater yield. All vineyards and orchards have been well manured and fertilized, and the splendid growth which has been put on in consequence, promises a good crop next season. As much as possible of the grape crop was sold, it being considered more advantageous to sell than to turn it into wine, owing to the closing down of the farm. The wines made were as follows:—Hermitage, 4,508 gallons; Sauvignon Blanc, 2,424 gallons; Sweet Constantia, 424 gallons; Press Wine, 1,360 gallons. Owing to the advertising of our wines, sales greatly increased, but lately, owing to shortage of packing material and non-advertising, sales have decreased.

No. III (f).—GOVERNMENT GUANO ISLANDS.

Superintendent: W. R. ZEEDERBERG.

1. *Production of Guano.*—As foreshadowed in the last report, there was a very considerable shortage in the quantity of guano produced during the breeding season of 1923-24, as compared with the previous season, the total collections from all sources being only 8,520¾ tons.

The following return gives the yield of guano and the quantities brought up to Cape Town during the year 1924 as compared with 1923:—

Island.	Collected.		Brought to Cape Town.	
	1923.	1924.	1923.	1924.
Colonial Group.	Tons.	Tons.	Tons.	Tons.
Malagas Island	1,060½	453¾	1,060½	453¾
Bird Island	311¼	378¼	311¼	378¼
Lamberts Bay Island	332¾	261	332¾	261
Jutten Island	591¼	255½	591¼	255½
Dyers Island	343¼	221¼	313¼	251¼
Dassen Island	619	113¼	619	113¼
Paternoster Island...	124½	74¼	100	124½
Marcus Island	40	55½	40	55½
Seal Island (False Bay)	18¼	24¾	18¼	24¾
Elephant Rock	27½	17¾	27½	2¾
Duiker Klip	Nil	5½	Nil	5½
Foundlings Island...	46½	Nil	46½	Nil
Totals	3,514¾	1,860¾	3,460¼	1,926
Northern Group.				
Ichaboe Island	3,284¾	3,000½	3,374¾	3,000½
Possession Island	1,805	1,942¼	1,713½	2,028¾
Mercury Island	475¾	513	475¾	513
Penguin and Seal Islands... ...	Nil	419	Nil	419
Halifax Island	582½	408¼	503	830¾
Pomona Island	172½	172	172½	172
Sinclairs Island	173	125	173	125
Plumpudding Island	87½	80	21½	66
Hollamsbird Island	Nil	Nil	Nil	Nil
Totals	6,581	6,660	6,434	7,155
GRAND TOTALS... ...	10,095¾	8,520¾	9,894¼	9,081

The reserve stock of guano (being the balance left over of the 1924 crop) on hand on the 31st December, 1924, was 5,265½ tons, of

which 1,855½ tons still remained on certain islands on that date. The whole of this quantity was disposed of in the first allotment this year (1925).

2. *Demand for Guano.*—There has been a further very notable increase both in the number of applications and the demand for this fertilizer, more particularly from the Transvaal. The total number of applications received during 1924 was 5,316 for an aggregate quantity of 17,749½ tons, as compared with 4,383 for 13,292½ tons in the previous year.

3. *Allotment and Sale of Guano.*—The total quantity of guano disposed of throughout the Union between 1st July, 1924 and 30th June, 1925, was 9,874 tons, of which 9,847 tons were sold by allotment and 27 tons through the medium of the Knysna depot. The usual allotments were made during this period, viz.:—One in July, 1924 (being the second for that year), with regard to which 1,998½ tons were sold and distributed, and another in February, 1925, when a further 7,848¼ tons were disposed of. The number of applications received and considered in connexion with these two allotments was 2,374 and 3,624 for aggregate quantities of 5,775 and 17,691¾ tons of guano respectively.

4. *Distribution of Guano,* 1924.—The total quantity of guano applied for during the calendar year 1924 (including applications from other Government Departments) was 17,749½ tons, and the actual quantity disposed of in the same period was 7,991 tons, 89.43 per cent. of which was absorbed by the western and south-western districts of the Cape Province. Of this latter quantity 6,298¼ tons, representing 78.82 per cent. of the total year's sales, were distributed between the Malmesbury, Cape, Paarl, Stellenbosch, and Caledon Districts alone.

SUMMARY OF DISTRIBUTION.

	1923. Tons.	1924. Tons.
Cape Province—		
Western and south-western districts ...	9,767¾	7,146½
Other districts	98¼	104
Total	9,866	7,250½
Transvaal (all districts)	478	604½
Natal (all districts)	152¼	101¼
Orange Free State (all districts)	29	34¾
Zululand	6¼	—
GRAND TOTALS	10,531½	7,991

5. *Analytical Composition of Guano.*—The average composition of the several stocks of guano disposed of during the year 1924 was:—Phosphoric oxide soluble in water, 3.1 per cent.; phosphoric oxide soluble in 2 per cent. citric acid solution, 11.7 per cent.; total phosphoric oxide, 12.3 per cent.; nitrogen, 9.4 per cent.; potash, 1.7 per cent.; lime, 12.7 per cent.

6. *Guano Prospects for* 1925.—The season 1924-25 has again not been a good one, in so far as the production of guano is concerned. Notwithstanding the fact that the birds were fairly numerous, owing to the general scarcity of small fish on the coast during their breeding season, the resultant deposits were, in most instances, and more particularly on the Colonial islands, very poor and disappointing. All these have been collected, but until the balance of the collections has been brought to Cape Town, it is not possible to say what the season's crop will amount to. From a rough estimate which has been made of the quantities still on the coast it will in all probability be about the same as that obtained last year (1924), possibly a little less, thus making a further shortfall in the year's supply of approximately £30,628, or an average of 37s. 7d. per skin. The Union Government's share of this amount was £18,291.

7. *Sealing.*—Most successful operations were undertaken during the sealing season 1924 on Dyers Island, Quoin Rock, and Elephant Rock, in the Colonial group, as well as—for the joint account of the Union Government and the South-West African Protectorate Administration—at Cape Cross and the various islands and rocks off the South-West African coast. The total number of skins secured from all sources was 16,438, of which 3,303 were obtained from the Colonial islands and rocks and 13,135 from those in the northern groups. Of the latter number, 5,938 were taken on behalf of the Protectorate Administration. All these skins were shipped to London and sold by public auction, the total gross amount realized for the same being £30,628, or an average of 37s. 7d. per skin. The Union Government's share of this amount was £18,291.

8. *Seal Oil.*—The total quantity of seal oil produced last year was 8,063½ gallons, for which there was a fair demand. The revenue derived from the sale of this oil was £823.

9. *Sale of Penguin Eggs.*—The total number of penguin eggs collected from Dassen Island during the season 1925 was 527,400, from which source a revenue of £3,362. was collected.

REPORT No. IV.—BOTANY AND PLANT PATHOLOGY.

Chief of Division: I. B. POLE EVANS, C.M.G., M.A., D.Sc., F.L.S.

1. *General.*—The work of the Division is still severely handicapped through lack of necessary accommodation. The storage researches on fruit at Cape Town are still waiting for laboratory facilities. The building which was to be equipped as a laboratory was vacated in September, 1924, but tenders for the alterations have only just been issued, and there is little prospect of completion of the work for many months. At headquarters the lack of accommodation is chiefly felt by the pathological section and particularly by the cryptogamic herbarium, which is hopelessly overcrowded and badly lighted. In this section also, owing to insufficient assistance, it has been found impossible to keep up with the ordinary routine work; the work on the fungus exchange collection is at a standstill and it has been impossible even to fulfil our obligations to other herbaria which have generously supplied us with specimens.

2. *Staff.*—The Assistant Chief, Dr. E. M. Doidge, returned from leave at the end of September, having represented the Department at the Imperial Mycological Conference and attended the mycological section of the Imperial Botanical Conference. The chief feature of the mycological section was the appreciation shown by mycologists from all parts of the Empire of the work done by the Imperial Bureau of Mycology. A strong recommendation was made that the Bureau be continued and that it be given facilities to extend its activities. The Union Government has granted the increased support which was requested.

Dr. E. S. Moore assumed duty on the 14th July, 1924, to undertake research work in connexion with tobacco diseases, and particularly to investigate wildfire in tobacco.

Mr. V. A. Putterill, M.A., returned from England in November, 1924, after twelve months' work in the Low Temperature Research Laboratories at Cambridge and elsewhere.

Mr. H. A. Melle was transferred to the Division of Animal and Field Husbandry at the expiration of his leave in November, 1924. His post has not yet been filled.

Two of the vacancies on the staff of the National Herbarium caused by the resignation of Miss J. Davison, B.A., and Mr. F. N. Howes, M.Sc., were filled by Mr. A. P. D. McClean, M.Sc., and Mr. C. A. Smith, B.Sc., who were appointed on the 31st January, 1925. Mr. R. A. Dyer, M.Sc., who was appointed on the 31st March, assumed duty as botanical survey assistant in the south-eastern area. Miss Stella Gower, artist to the Division, resigned on the occasion of her marriage, and the post was filled by Mr. P. Badenhorst, who was appointed on the 7th May. Mr. C. J. Hopkins, B.Sc., joined the staff as mycologist on the 28th February.

3. *National Herbarium.*—The usual routine work has made large demands on the time of the staff, over 5,000 determinations having been made for farmers, workers on the botanical survey and other Government departments. Some 2,057 specimens have been acquired, of which 235 were species new to the herbarium.

The exhibit in the demonstration train was rearranged, and an exhibit of noxious weeds prepared for the agricultural shows.

Some sixteen papers were prepared for publication by the staff, including a number of important contributions to our knowledge of the South African grasses, which were contributed by the agrostologist.

4. *Botanical Survey.*—A preliminary survey has been made of the southern slopes of the Blaauwberg Mountains, Transvaal, and a systematic study of the vegetation of Pretoria and its environs is being carried out. Progress has also been made with the bushveld reserve in the Northern Transvaal. A Karroo reserve has been acquired at Fauresmith, Orange Free State, where work on the native flora will be commenced. In the south-western area, the Clanwilliam mountains were explored, and many interesting and undescribed plants were brought to light; Dr. Schönland continued his work on the noxious weeds of the eastern Cape Province. The investigations on the flora of Natal were continued by Dr. Bews, and his latest results will be embodied in a paper now in the press as a Memoir of the Botanical Survey. Dr. J. Muir completed a detailed ecological and systematic account of the Riversdale flora, and a revised genera of South African plants compiled by Dr. Phillips has been brought to completion.

The botanical survey of South Africa was ably represented at the Imperial Botanical Conference, held in London last year, by Drs. Schönland and Bewes.

5. *Plant Diseases: Advisory Work.*—The usual large number of inquiries about plant diseases has been dealt with, crown-gall in deciduous fruit trees and the apple-cracking disease (*Coniothecium chomatosporum* Corda) having been extremely prevalent. The dry-rot of maize (*Diplodia Zeae*) has also commonly occurred. Diseases of sugar-beet are of particular interest in view of the intention to plant this crop on a large scale in the Transvaal. Root-rot caused by *Rhizoctonia* (*Corticium vagum*, var. *solani*) was identified on sugar-beets from three localities where the crop was being grown experimentally, and may prove a factor to be reckoned with.

The pathological exhibit in the demonstration train was prepared and arranged.

6. *Research and Administration*: (*a*) *Diseases of the Virus Group*— (i) *Streak Disease of Maize and Sugar-cane.*—Investigations carried out at the Natal Herbarium, Durban, into the condition of maize well-known in Natal, even before the beginning of the present century, under the name of "variegation," have shown it to be a specific, transmissible disease. A new leaf-hopper of the family Jassidae, *Balclutha mbila* Naude, has been proved to be capable of transferring the disease from variegated to healthy maize plants. Many other insects have been tested for the power of transmission without success. The process of disease transmission by *Balclutha mbila* has been subjected to close study, and, in particular,

attention has been given to the mode of overwintering of the disease, as affording the most hopeful point at which control measures might be applied with success. Similar studies have shown that the recently recognized streak of sugar-cane may also be transmitted, under favourable circumstances, by *Balclutha mbila*. There is considerable evidence that actually a single disease is responsible for this condition in both hosts, but experimental proof of this point is not yet available.

Field experiments, carried out in co-operation with the South African Sugar Association, have given a convincing demonstration of the ill-effects suffered by the Uba variety from infection by this disease. The control measures which have been recommended to planters—the selection of seed cane, and the subsequent roguing of the young plants—have given good results in certain localities. The experience of the past season has tended to show, however, that over the greater part of Natal and Zululand the incidence of infection is so heavy that there is little hope of keeping healthy plantings of the Uba variety free from the disease for more than a few months.

(ii) *Mosaic Disease of Sugar-cane and other Grasses.*—Extensive field and experimental studies have been prosecuted upon the distribution of this disease, the susceptibility of different hosts, and the transmission between different hosts. In particular, a search has been made for possible overwintering hosts other than the sugar-cane.

A quarantine greenhouse of the most modern type has been built by the South African Sugar Association at the Natal Herbarium. The policy of procuring promising varieties of cane from overseas has been strongly advocated by the Division as a means of solving the disease problems of the cane grower. The risk of introducing new diseases in imported cuttings is great, and the Division was prepared to agree to importation only on the condition that the most stringent quarantine be enforced. The imported setts will be grown for a year or more in the new greenhouse, under the control of the Government Mycologist and Entomologist at Durban.

(iii) *Rosette Disease of Peanuts.*—During the past season attention was given to the possibility of the dissemination of this disease by insects, since its general characters indicated that it belonged to the virus group. Collections were made of all the sucking insects to be found on the diseased peanut plants, and these insects were allowed to feed on healthy plants under controlled experimental conditions. No infection followed the feeding of any insect except *Aphis leguminosae* Theo. The latter insect produced the disease in a large proportion of the experimental plants, and in all probability is the important agent in the spread of the disease in the field. This work was carried out at Pretoria and in the Potgietersrust District, and the results were confirmed in an independent series of experiments at Durban.

(*b*) *Citrus Diseases*: (i) *Citrus Canker* (*Bacterium citri*).—The exceptionally heavy rains which continued late into the autumn provided, for the first time since 1918, ideal conditions for the development of citrus canker. In the experimental orchard at Buffelspoort, which was planted on the site of an infected orchard destroyed in 1918, no less than 25 trees developed the disease and were immediately destroyed. These were all in the neighbourhood

of the worst infected trees in the original Smithfield grove. In addition to this, one infected tree has been found in an orchard at De Kroon, where three canker-infected trees were destroyed in 1918-1919. All this evidence goes to show that the policy which the department has followed in this matter is a sound one, and that had replanting of infected sites been allowed—as many growers have frequently urged—we should have been faced this season with a second serious outbreak of canker.

(ii) *Brown Rot of Citrus* (*Pythiacystis citrophthora* R. and E. Smith).—The late rains also created ideal conditions for the development of this fungus. It had not previously been identified in South Africa, but has probably been present in a number of localities without doing much damage in normal seasons. During April there was a serious outbreak of this disease, causing considerable loss of fruit, especially in the Marico District and the Northern Transvaal. Information about brown rot and advice with regard to treatment were published in the *Journal*.*

(iii) *Lemon Leaf Spot and Centre Rot of Oranges* (*Alternaria* sp.).—Studies are in progress which tend to show that the leaf spot fungus often causing defoliation of lemon stocks is identical with the *Alternaria* causing centre rot of navel oranges. A number of different strains of the organism are under observation.

(iv) *Scaly Bark and Collar Rot.*—A number of field studies were made in connexion with these diseases during trips to the Northern Transvaal, Rustenburg District, and Natal, on the occasion of Dr. Webber's visits to these areas.

(v) *Concentric Ring Blotch.*—Field studies of this disease show that the first spotting of the leaves develops on the second flush of growth about January. This seemed to suggest that the disease might be due to an organism, and a bacterium was repeatedly isolated from leaves showing ring blotch. Attempts to reproduce the disease by inoculation, however, have only led to negative results. Ring blotch on the fruit has been common this season.

(*c*) *Other Plant Diseases*: (i) *Wildfire in Tobacco* (*Bacterium tabaci*).—Particular attention is being given to the study of the life of the organism during the winter and of the method of infection in spring. Possible control measures, such as the use of fungicides, have been tested during the season by both garden and greenhouse trials. The transmission of infection by the seed and the question of seed treatment are also under consideration. In addition, a preliminary study has been made (occupying fully two months) of the possible existence amongst plant parasites of anything resembling d'Herelle's Bacteriophage. The results obtained indicate that new conclusions of far-reaching importance may arise out of further investigation along these lines.

(ii) *Wart Disease of Potatoes.*—No new outbreaks of this disease have been discovered, and it is hoped that infection is confined to the two sites near Impendhle, Natal. The infected sites near Impendhle were treated with heavy applications of sulphur in an attempt to destroy the wart disease organism. This substance was adopted upon the advice of Dr. Brierley, of Rothamstead, and has given results of great promise in experimental trials in England.

* June, 1925.

In spite of this treatment, the prohibition upon the growing of any varieties of potatoes, other than approved immune ones, and upon the removal of *any* potatoes *from* these farms will remain in force. These measures are considered to give the greatest possible security to the rest of the farming community.

(iii) *Brown Spot in Pineapples.*—The investigation of this disease was continued both at Pretoria and at Langholm, facilities for field work being provided by the management of the African Canning and Packing Corporation, Ltd. Special attention was given to the following points:—Inoculation with pure cultures of *Penicillium* spp., spraying experiments, possible sources and methods of infection, and conditions favourable to infection.

(iv) *Crown Gall.*—The question of crown gall infection in nurseries and orchards has been given considerable prominence in the Press. During a visit to Sundays River Valley in August last, crown gall was found in the deciduous orchards in six out of the ten orchards visited; and this probably reflects the position throughout the country. It is regretted that in many cases orchard infection is still traceable to the carelessness of nurserymen in sending out infected nursery stock. A series of experiments has been planned and is being carried out at the School of Agriculture at Elsenburg in connexion with the disinfection of stocks and of the soil, and a search for varieties suitable for stocks which are resistant to crown gall. The latter is the most promising line of investigation, but is one which must of necessity proceed slowly.

(v) *Black Rot in Quinces.*—An unrecognized black-rot disease in quinces, due to a fungus, was reported as causing considerable damage to the fruit in the Magaliesburg area. The organism was isolated and grown in pure culture, and produced typical infections in sound fruits within a few days of inoculation. In the absence of any fruiting bodies, it was not possible to identify the organism.

7. *Cryptogamic Herbarium.*—The need for further accommodation and assistance has been stated elsewhere. Some 642 specimens have been added to the herbarium, and numerous fungi have been identified for the Forestry Department and for the public.

Several new agarics have been described and photographed ready for publication.

Amanita phalloides has been recorded for the first time in South Africa from Harrismith, where it was the cause of three deaths.

The revision of the South African *Uredineae* has been commenced, and considerable progress has been made in the study of the genus *Puccinia*.

8. *Storage Researches on Fruit:* (i) *Physiology of Stored Fruit.*—Preliminary investigations on deciduous and citrus fruits are being carried out at Cape Town. The work on pears has already shown considerable promise as it has drawn attention to the great difference in keeping qualities of pears from different areas even of the western Cape Province. The effect of atmospheric humidity and rain compared with irrigation is important, as obviously the transpiration of trees must differ very considerably. It is noticeable that the dry climate fruit is superior in keeping qualities.

With regard to citrus, the bulky nature of the fruit makes the storage of any reasonable quantity difficult. The work is on broad lines and includes respiration changes. Recent American researches have shown that certain chemicals, such as borax, have a distinct inhibiting effect on mould growth, and this question is being investigated.

A general survey of grape export indicates an extremely unsatisfactory state of affairs from the scientific aspect. A few growers obtain an average throughout the season of 25s. per 10-lb. box of grapes, whereas others from the same district find their fruit only fit for sale on coster barrows in London. There is urgent need for scientific investigation as against rule of thumb methods, and also for sound technical instruction by the Department.

(ii) *Work in Conjunction with the Railway Administration.*—During the early part of the year the question of precooling facilities was fully discussed by the Railway Administration, shipping companies, Harbour Advisory Board, Cape Town Chamber of Commerce, and private cold storage interests.

It was first suggested that a new shed on No. 7 Quay should be converted, but this scheme when finished did not meet with the approval of the Railway officials, and it was urged that the East Pier should be used. After much discussion, this was authorized and plans were prepared. The work of demolition commenced in January, and there is good prospect of having about two-thirds of the scheme ready by the next deciduous season. All the work is being done departmentally, and this method has involved a heavy demand on the time of the Government Physicist, as the preparation of all specifications and detail drawings has had to be supervised.

The export for the last season has amply justified the contentions made by this Division when urging the construction of quayside facilities. The total export increased by 50 per cent., and a combination of circumstances led to a complete breakdown of the private cold stores, for which big claims had been made. In fact, conditions became so critical that for a week all growers had to stop forwarding any fruit for export.

(iii) *Refrigerator Trucks.*—The investigation on refrigerator trucks has made good progress, and a satisfactory type has been evolved. The Salt River workshops are now modifying a number of these trucks in readiness for the next season's traffic from the north.

(iv) *Farmers' Cold Stores.*—A request was made by Elgin farmers for assistance in the design of a cold store for their produce. As this was a matter of general interest to all farmers, it was agreed to put forward a complete design for a store, conditional upon the full details of cost and construction being published when complete.

(v) *Dehydration.*—It is well known that extensive plantings of fruit for purely drying purposes have been made in the Union during the past few years. The conditions under which this fruit is grown and the quantities which will be produced are such that sun drying is out of the question, and mechanical dehydration will be necessary. The Longhope settlers applied through the Land Bank for assistance, and the design and specification of a plant, to be built in units to meet their demand, are in preparation.

REPORT No. V.—ENTOMOLOGY.

Chief of Division: C. P. LOUNSBURY.

1. *General.*—The functions of the Division comprise: (1) The application of Government regulations concerning (*a*) the inspection of plant nurseries and restrictions on traffic in plants and fruits, and (*b*) plant, fruit, and apicultural imports; (2) the dissemination of advice on insect problems by correspondence, publications, and otherwise; (3) the conduct of experiments and demonstrations with measures for suppressing insect pests; and (4) life-cycle and technical studies on insects of economic importance.

During the year the Division was strengthened by two appointments on the higher and one on the lower scale for the technical division: F. G. C. Tooke, M.Sc. (Cornell), was appointed on his return from scholarship studies in America and assigned to the investigations on forest insects, in particular the eucalyptus snout-beetle and the eucalyptus borer. A. J. Smith, B.Sc.Agr. (South Africa), assumed duty at the beginning of the year reviewed and was assigned to tsetse fly investigations. C. J. Joubert, B.Sc. (Stellenbosch), assumed duty early in January and was placed under the entomologist of the Elsenburg School of Agriculture as general assistant, but specially with reference to pests of western Cape Province orchards.

Two further appointments on the higher scale have been made since the expiry of the year. Francois Taylor, B.A. (Cape Town), assumed duty late in July and was placed under the entomologist of the Potchefstroom School of Agriculture, who is working specially on the insect pests of maize in the field and in storage. G. A. Hepburn, B.Sc. (South Africa), also assumed duty late in July and was placed under the entomologist at the Cedara School of Agriculture, whose special work is chiefly on cutworms and on insect pests of the wattle tree. Two other men were taken on as entomologists under contract with the Empire Cotton Growing Corporation. They are C. L. Chapman, B.Sc. (Edin.), and T. C. Cairns, B.Sc. (Edin.). By arrangement, Mr. Cairns was put on tsetse fly investigations, and thus Mr. A. J. Smith, aforementioned, who is more highly qualified entomologically, was obtained for cotton insect investigations in addition to Mr. Chapman. The two B.Sc.Agr. men had taken four-year university courses and had majored in entomology, but they lacked the great advantage of post-graduate study. The four B.A. and B.Sc. men had taken only three-year university science courses, and all lacked really specialized training in entomology, such as entomological recruits for the Department should possess on entering; but, as pointed out in previous reports, the preparation of recruits is being neglected, and properly qualified men not being available, the Division has to make shift with the best material it can obtain under the prevailing conditions.

The Division continues to be much under-staffed for the duties it is called upon to perform, and it also suffers considerably from what may be described as "growing pains." As the staff has increased the policy has been followed of having as many technical officers as practicable devoting themselves to the solution of specific problems, as opposed to superficial attention to many problems. The policy unquestionably is a sound one; but in the present stage of development of the Division, its conduct is necessarily extremely burdensome on the headship. The work at headquarters is chronically congested. Furthermore, the holding of the officers to specific investigations as largely as is compatible with carrying on the routine work, unavoidable in their respective positions, necessarily stands in the way of giving much assistance in itinerant "extension" work. Much of the extension work desired in entomology, however, is of an elementary nature, which the ordinary field officers of the Division of Extension should be qualified to perform, and which such officers may be expected to carry on satisfactorily in the course of time. The only officer of this Division who should be much required for itinerant extension duties is the apiculturist, and he devotes no small share of his time to them.

The force of entomologists under the direction of the Division, inclusive of those recently engaged, consists of the chief, assistant chief, one each at Cape Town, Port Elizabeth, East London, and Durban, two for locust investigations, three for cotton insects, one for tobacco insects, one for forest insects, one for apiculture, one on tsetse fly investigations, and two each at four schools of agriculture—Elsenburg, Grootfontein, Potchefstroom, and Cedara—a total of 23. The four officers at the several seaports supervise the introduction of plants and other articles restricted under the *Agricultural Pests Act*, and five of the officers at the schools have teaching duties.

The Annual Report is deemed the proper medium in which to record observations on the growth of the Division and statistics and observations on the inspectional phases of its work. The value of the Division to the country, however, consists largely in its investigations, and the accumulation of new knowledge on the insect pests of the country that may be turned to advantage in combating these pests; such matters are best dealt with in special articles from time to time, which are published in the official *Journal* or bulletins of the Department, in the *Entomology Memoirs*, or other appropriate publications. The lines of investigation being followed by the various officers were discussed in the last Annual Report, and it is considered desirable to comment in this report on only a few such matters.

Years ago the writer held the opinion that crops in South Africa did not suffer from the depredations of native insects proportionately as much as some other countries, notably Canada and the United States; but in late years, as agriculture and horticulture have assumed far greater commercial importance, it has become obvious that this end of the "dark continent" warrants an evil reputation for indigenous insect pests of crops, even as it has long borne the reputation of being exceptionally plagued with stock diseases. Other conditions of the Union, however, perhaps much more than counterbalance the liability to excessive losses through insects; and there seems no reason to fear that the chief pests cannot

be successfully combated. The outlook is gloomy for haphazard farming; but the progressive farmer, who really makes a close, intelligent study of his crops, and properly avails himself of the knowledge of our insect pests disclosed by investigations, may confidently expect rich reward. Amongst the insects that have taken to cultivated crops from native vegetation, and assumed high rank as pests, are the maize-stalk borer (*Busseola fusca*), Sudan cotton boll-worm (*Diparopsis castanea*), and false codling-moth (*Argyroploce leucotreta*). The last-named insect has become a grave pest in oranges in various summer rainfall districts. These several insects have got their opportunity through the extensive commercial cultivation of vegetation suitable to them. In a sense they are unnatural pests inasmuch as their prominence has arisen from the farmer's disturbance of natural conditions; he has given them bounteous concentrated sources of food supply in place of thinly scattered ones, which nature designed they should find only at imminent risk of failure. The problem for the Government is to find methods by which the advantage of abundant food may be offset, and the problem for farmers is to make the best use of such methods in their farming practice. Satisfactory solutions of the problems may be forthcoming only very slowly. For a quick solution of the problem, so far as the Government is concerned, larger staffs of expert investigators might have to be employed; but it is impracticable for the country to provide adequately for such services.

2. *Locust Investigations.*—The Union has continued to suffer heavily from the brown locust (*Locustana pardalina*), but there are signs that the present great cyclical visitation of this serious pest is collapsing, and that years of comparative immunity from its depredations may soon be expected. The administration of Government operations for the suppression of migratory locusts now rests with another section of the Department.

No occurrence of the red locust (*Cyrtacanthacris semptemfasciata*) came to light during the year. Great visitations by it on previous occasions have appeared to follow a few years after cycles of the brown locust, and, therefore, it is feared that trouble with it may be brewing.

A positive start on "locust research" has at last been made. Two entomologists, Dr. C. W. Mally and Dr. J. T. Potgieter, now devote themselves exclusively to the subject. Dr. Mally who, with numerous other duties, has for over twenty years given some attention to the study of locusts and measures for their control, is in charge. For many years he has been regarded as the best qualified man in the country for this line of work. The assignment of officers specially to locust investigations was long in contemplation, and the actual start was hindered rather than helped by agitation from outside of the Department. A scheme to co-operate with an external institution in order to get the services of an entomologist who was formerly engaged in locust studies finally had to be dropped through no fault of the Department. It can plausibly be argued that the project of locust research is of such great importance to the country, in view of the enormous expenditure the Government has seen fit in recent years to incur in carrying out measures to suppress the pest, that the establishment of a permanent locust research board

vested with wide powers, employing half a dozen or more entomological specialists and its own chemists and engineers and other experts, and having its own clerical staff, and being responsible directly to the Minister of Agriculture, would be fully justified. The field for possibly profitable inquiry is certainly a very wide one, embracing as it does not only the biological study of the migratory locusts themselves, and of the numerous parasites and predaceous insects and diseases that influence the measure of their multiplication, the association of the locusts with birds and other forms of higher life, and materials and apparatus for combating the pests, but also the elucidation of the underlying causes, not unlikely climatological in the main, that account for the phenomenon of locust cycles. But saying what should be done is one thing and putting it into practice quite another. At least a beginning on systematic investigation has been made; and perhaps ways and means of extending the present scope of the work will gradually be found. The two entomologists deputed to the investigations were obtained by sacrifices. Their former positions are left vacant. Dr. Mally was transferred from Cape Town, and his transfer is a grievance with the fruit growers in the western Cape Province. Dr. Potgieter was taken from the Glen School of Agriculture. Already good progress has been made in the study of parasites of the locust. Three years ago Dr. Mally introduced finely powdered arsenite of soda for use in poisoning locusts where water was not available for spraying or baiting. In recent months he has succeeded in improving the physical condition of the powder; and by this step alone he calculates a saving of £10,000 in respect of an order since placed for a fresh supply. A Dodge motor-van and a six-wheeled twelve-tyred Renault motor-truck were provided for his work. By the aid of the truck, it is anticipated he will be able to pursue investigations in sandy desert country.

3. *European Corn Borer.*—Nearly two pages of the last Annual Report were devoted to this insect (*Pyrausta nubilalis*), which it was feared had become established at Johannesburg through importations of broom corn. The precautionary measures described last year were kept up throughout the year under review, and at the close of the growing season the débris of maize plants grown in the suspected locality was gathered and burned as before. It is gratifying to be able to record that no indication of the presence of the dreaded insect was found away from the moth-proofed building in which imported broom was stored. As elsewhere noted, the importation of stalked broom corn is no longer allowed. The manufacturers of brooms complain that South African broom corn is much more heavily infested with borers than the broom corn that was imported from Europe and South America, from where supplies were formerly drawn. There is sound foundation for the complaint. The borer is believed to be the native maize-stalk borer (*Busseola fusca*) mentioned in a preceding paragraph.

4. *Eucalyptus Snout-beetle.*—The importance of this rather recently introduced Australian insect became gravely accentuated during the year by its depredations in extensive plantations in the Witwatersrand area, where the very susceptible *Eucalyptus viminalis* is the commonest species. Thousands of acres of eucalyptus trees are threatened with destruction. The insect is spreading rapidly over the Union and is already widespread both in the south-west and

south-east of the Cape Province, in central Natal, and over a large territory around Johannesburg in the Transvaal. There is some hope that parasites which, if introduced, would materially check its multiplications are to be found in Australia. A co-operative search for such natural enemies is being arranged with the Department of Agriculture of New Zealand, another country to which the insect has spread. There is also a little hope that the poisoning of the larvae through the use of an aeroplane to distribute an arsenical dust over the trees would prove practicable in large plantations of vigorous trees in areas favourable for flying; experimental aeroplane-dusting of a plantation, through the co-operation of the Air Services of the Defence Department, is accordingly contemplated during the coming summer. Aeroplane-dusting for the suppression of insects in cotton fields and orchards has made remarkable progress in the United States during the last year or two, and a special type of aeroplane for the purpose has been developed. Our experiments will have to be performed with one of the war machines now owned by our Defence Department, but through the courtesy of the U.S.A. Department of Agriculture we have been supplied with detailed specifications for the alteration of an available model to fit it for the projected work. It will probably be many years before the insect is brought under control by any means, and meanwhile the wisdom of setting out plantations of the more susceptible kinds of eucalyptus, particularly *viminalis* and *globulus*, anywhere in the country is seriously open to question.

5. *Nursery Inspection.*—The total number of nurseries registered again shows a light decrease, being 389 against 400 in the previous year, and 410 two years ago, but the inspection duties became much more onerous owing to the increasing gravity of the pernicious scale situation. There was a decrease from 189 to 181 in the Cape Province; a decrease from 141 to 135 in the Transvaal; a decrease from 40 to 37 in the Orange Free State; and an increase from 35 to 36 in Natal. The fees for registration, £5 a year for a fruit tree or rose nursery, and £2 a year for a nursery not cultivating fruit trees or roses, amounted to £1,406, and £25 additional was received for extra inspections, etc. The number of nurseries exempt from a registration fee was 47, as in the previous year. The exempted nurseries comprised, as before, 38 Government forest nurseries, 6 railway nurseries, and 3 others maintained by Government departments.

The total numbers of plants of different classes reported by the nurserymen as expected to be ready for sale during the year, and the corresponding numbers for the previous year, were:—

Class of Nursery Stock.	1924 25.	1923 24.
Citrus fruit trees...	926,800	1,141,590
Deciduous fruit trees	3,694,572	3,535,660
Other fruit trees	47,032	46,175
Forest trees	20,455,208	18,945,188
Roses	520,576	537,543
Vines	1,155,705	1,646,875
Other hardy plants	2,546,448	2,240,300
Greenhouse plants	270,121	253,917

The registration of exclusively vine nurseries in the main viticultural area is not required and the figures for vines are to this extent misleading. Hedge plants, palms, and ornamental shrubs are grouped together under " other hardy plants." The main incidence of inspection is on fruit trees, roses, and ornamental shrubs. The number of fruit trees in nursery rows, but not expected to reach saleable conditions during the year, was reported to be: Citrus 1,330,784; deciduous 2,800,150, in 1924-25, as against 1,477,360 and 3,164,200 respectively the previous year.

The figures for citrus trees show a substantial drop, and approximate to those for the year 1922-23. The demand for citrus trees, although apparently tending to decrease, is still very strong. The figures for deciduous trees continue on the rise and are double what they were seven years ago, while those for citrus are no greater than they were then.

Twenty-two quarantines were applied to nurseries during the year, and four remained in force from the previous year. All the new quarantines were on fruit-tree nurseries. For the first time, red scale was not the cause of most quarantines: Pernicious scale (*perniciosus*) has come to rank highest and will probably long retain this shameful supremacy. Nine new quarantines were wholly due to it, 7 wholly to red scale (*aurantii*), 2 to woolly aphis of apple, 1 to circular purple scale (*ficus*), 1 to white peach-scale (*pentagona*), 1 to grey scale (*pectinatus*) and red scale, and 1 red scale and woolly aphis. The stock in quarantine aggregates about 150,000 deciduous fruit trees and 15,000 citrus trees. One nursery near Johannesburg remains from the previous year in quarantine for crown gall and root gall-worm, but removal of stock under the personal supervision of a plant inspector is allowed.

Pernicious scale has continued to advance in the three northern Provinces. It spreads in ever-widening rings from tree to tree, from garden to garden, and from farm to farm as it was twelve years ago predicted it would. As at this date not a single occurrence of the dread pest is known anywhere in the Cape Province, and the Division is naturally proud of having held it back. But it is practically inevitable that the pest sooner or later will appear in the southwestern fruit districts, and when it is found it will be almost sure to be well established and already to have spread indefinitely. The prevalence of the pest along the populous Witwatersrand, which has come about by natural spread in the last few years, greatly increases the risk of infested plants being taken to the Cape. During the past year three outbreaks were discovered in Maritzburg, two in well-known nurseries, and the other in a private garden some miles away; the nursery occurrences were slight, and the plants were destroyed. Better to safeguard the Cape Province, additional regulations were brought into force during the period reviewed. These provide that any removal of kinds of plants suspected of being food-plants of the scale into the Cape Province from any place in the other three Provinces shall be under special permission of the Division. A great deal of additional inspection and fumigation work has thus been thrown on the Division; but it is feared that many small lots of plants from pernicious scale infested premises get to the Cape undetected in violation of the regulations, both through ignorance and through deliberate disregard of the requirements. The

measures being taken to apply the regulations have disclosed a considerable trade in nursery stock to the Cape, particularly from Johannesburg. Even prominent Cape fruit growers, notwithstanding all the warnings about pernicious scale, fall to the temptation of placing orders in the northern Provinces. The explanation is largely alluring advertisements.

Crown gall and *root gall-worm* continue to give much trouble in deciduous fruit-tree and rose nurseries. As explained in previous reports, affected plants are to be found in the best nurseries, and it is practically unavoidable that even the most reputable nurserymen will supply some to customers. Only by having an inspector at each nursery to inspect critically every plant of susceptible kinds just before packing could the distribution of affected plants from nurseries be effectively stopped; and such a measure would be quite impracticable owing to its enormous expensiveness. Moreover, the degree of importance of these troubles as factors of loss in orchards does not justify the grave fear in which their occurrence in nursery stock is commonly held by fruit growers. A purchaser of plants would be well advised to examine them and reject any that he sees are affected; but he certainly is not warranted in returning, as some people do, a large lot of trees simply because, on close inspection, he finds traces of the trouble. The return of plants cannot be sanctioned under the *Agricultural Pests Act*; but, as explained in last year's report, the sale of affected trees, as also of scale-infested trees, is illegal; and should a nurseryman demur at exchanging diseased trees, he would, if the Division were advised, be threatened with prosecution for having sold them. There were fewer complaints about crown gall on plants received than in the year before.

The citrus nematode (*Tylenchulus semipenetrans*) has been discovered in various citrus nurseries by microscopic examination of fine roots. It must be assumed that it is harmful to the trees, but there appears to be no way of detecting its presence, save by the compound microscope, and therefore no feasible way of checking its dissemination, except the drastic one of condemning all blocks of nursery stock in which it might be found. It has been demonstrated to occur in old orchards in both the south-western and south-eastern districts of the Cape Province, and in various parts of Natal and the Transvaal, but, as some of the trees on which it has been found appear perfectly healthy to the eye and to bear heavily, it does not seem reasonable to put restrictions on nursery stock because of it. Apparently it has long been widespread in the country. It is said to be practically ubiquitous in Californian citrus orchards, and is to be found in all parts of the world where citrus trees are grown commercially. The book advice for buyers of citrus trees "to specify that the trees be free from nematodes" is quite unpractical. The pest might be particularly abundant on his stock and the nurseryman entirely ignorant of the fact. And should a microscopic examination fail to disclose the creature in samples of root from a few random plants, it would be unsafe to conclude that all the stock was free of it; while conversely, were the creature found at a place it would not necessarily follow that the nursery was more infested than those where it was not found. To examine thoroughly for the worm a few samples of root from a nursery tree, costs as much as the tree is worth.

6. *Plant Import Regulations*: (i) *Plant Importations*.—The table and statement that follow summarize the quantities of plants of different kinds examined and passed by the port entomologists and their assistants. The figures in brackets in the table refer to the number of separate consignments, and the other figures to the number of plants:—

Kind.	Cape Town.	Port Elizabeth.	East London.	Durban.	Johannesburg and Pretoria.	Total.
Pear Stocks ...	169,000 (5)	—	—	11,000 (2)	—	180,000 (7)
Cherry Stocks ...	30,000 (4)	1,500 (1)	—	6,500 (2)	—	38,000 (7)
Plum Stocks ...	1,127 (2)	—	—	—	—	1,127 (2)
Fruit Trees ...	425 (19)	—	—	699 (6)	87 (4)	1,211 (29)
+ Cuttings ...	157 (3)	—	—	—	—	157 (3)
Bush Fruit Plants	161 (11)	—	—	136 (4)	59 (4)	356 (19)
+ Cuttings ...	330 (1)	—	—	—	47 (2)	377 (3)
Roses	397 (14)	36 (4)	101 (5)	187 (8)	199 (13)	920 (44)
Ornamental Trees, Shrubs, etc.	1,698 (26)	200 (1)	10 (4)	519 (20)	176 (5)	2,603 (56)
Palms	107 (4)	19 (3)	—	13 (2)	—	139 (9)
Carnations ...	7,582 (30)	5,784 (10)	611 (9)	15,806 (26)	1,912 (6)	31,695 (81)
Chrysanthemums	67 (2)	12 (1)	—	170 (6)	396 (7)	645 (16)
Other soft plants	1,355 (43)	392 (5)	322 (9)	646 (8)	638 (7)	3,353 (72)

There were also inspected and admitted 610 strawberry plants in 9 lots, and 18 banana plants, 4 vine cuttings and 3 sugar-cane cuttings in single lots, and a total of 425,117 bulbs.

As a whole, owing to increasing production in the Union and to the restrictions, the importation of plants from oversea tends to diminish. The fruit trees and roses admitted are of varieties not available in the country and are mostly for propagation purposes. The risk of introducing pests is greatest with the fruit-tree stocks, and it is hoped it will be practicable to exclude these plants within a few years. A considerable number of plants have to be removed from consignments every year because of infesting insects or crown gall. In the largest lot of pear stocks examined during the year reviewed, one from France invoiced as 100,000, 35 were seen to have woolly aphis on the root, 816 were infested with the *Epidiaspis betulae* scale, 130 had crown-gall swellings, and 914 were apple stocks; further, two clusters of moth eggs, probably *Orgyia antigua*, a European pest, were removed. These eggs promptly hatched. The introduction of apple stocks is prohibited, but the inclusion even of such a large number was probably unintentional. The inspectors frequently find apple stocks amongst pear stocks. A cluster of the moth eggs was also found in a consignment of pear stocks from Holland. As usual, finds at inspection comprised various scale insects, some known and some unknown in South Africa, various aphids, unrecognized boring insects, colonies of ants, and even earthworms and cutworms. But, generally speaking, the plants that arrive, other than fruit-tree stocks, appear free of insect infestation. This gratifying condition is unquestionably due to the introductions being largely of relatively high-priced, selected plants. Experience, however, has taught the Division that pests may come on plants from the best oversea nurseries, despite Government inspection before shipment. As an example, living mussel purple

scale was found a few months ago on a tree of a new variety of orange admitted from Florida. All woody plants are fumigated, and many are kept in quarantine for a year or more as an additional precaution.

(ii) *Potato introductions* comprised 39,436 cases in 262 consignments. The action in respect of potatoes remains unchanged. Documents in respect of black scab are rigorously insisted on, but the inspection is nominal, and no attention is paid to the occurrence of common diseases such as scab, blight, and stem-end rot.

(iii) *Fruit introduction* totalled 27,495 cases and barrels of apples, 224 cases of citrus fruits, 359 barrels of grapes, 645 crates of bananas, 202 cases of pears, and less than a hundred packages of other fruits, inclusive of mangoes and litchis. No material rejections of restricted fruits were necessary. The introduction of stone fruits is totally prohibited and some small lots of these fruits had to be confiscated.

(iv) *Restricted seed introductions* were trifling, but attention to them consumes very appreciable time. Peach stones are altogether prohibited. Cotton, lucerne, maize, and barley are very severely restricted, and acorns and chestnuts are admitted only under permit. Cotton-seed permits are only given in exceptional circumstances, and, during the year reviewed, what little cotton seed was released was picked over one by one as well as fumigated. Lucerne seed is now admitted only in small lots for testing at the Grootfontein School of Agriculture. Maize and barley seed is admitted only to the extent of 10 lb. of a variety to any person, and is disinfected with corrosive sublimate. The release of only 34 lots of maize, aggregating 258 lb., is recorded; this maize was almost wholly "sweet corn." The restrictions on acorns and chestnuts are designed to protect the country from weevils that infest these nuts oversea. Normally only small importations are made. Somewhat over 200 lb. of acorns arrived in two lots from America, and the sound ones were released. About a ton of chestnuts from Europe, imported for Christmas trade by Johannesburg merchants, were released after the worm-eaten ones, approximately 20 per cent., had been sorted out.

(v) *Restricted Plant Product Introductions.*—By a new regulation, the importation of broom corn must be under special permit, and permits are made conditional on the absence of any stalks that could shelter insect pests of the living plant. The broom manufacturers are as yet timid of importing under this condition, and the total imports recorded for the year were only 775 bales in seven consignments. Owing to the newness of the regulations and other extenuating circumstances, two consignments of broom corn with stalk attached were admitted early in the year, but the importers were required immediately to cut away and destroy the objectionable part.

A new regulation restricts the importation of unmanufactured cotton, the reason being fear of included seeds that might bring pink boll-worm. Introduction permits are given very guardedly, even samples being admitted only if it is practicable for the importer to arrange satisfactorily for their sterilization. The restrictions are applied fully to the produce of Portuguese East Africa, but only in modified form to Northern and Southern Rhodesia. Samples for grading are allowed to enter from Northern Rhodesia without treatment, but permits for bulk cotton from that territory are only given to provide for export through Cape Town. The arrangements for

cotton from Southern Rhodesia are more liberal, but necessitate the obtaining of permits through the Department of Agriculture at Salisbury. Bags in which cotton is sent to Portuguese East Africa are not allowed re-entry into the Union unless officially disinfected. Second-hand bags, of which there is a large importation into the Union for sale to grain and other farmers, will at least be casually inspected for cotton seeds in the coming year.

Unmanufactured cork from oversea has also been added to the formidable list of articles which the entomologists at the ports must watch for insect pests. Egg-clusters of the notorious gypsy moth have been observed on this commodity at a United States port. The imports into the Union are small.

7. *Beeswax Introductions.*—The precautions exercised for many years to prevent the introduction of bee pests and diseases continue to be kept up. No introduction of bees was permitted. Honey is prohibited and what little arrived was excluded from entry. Wax is admitted freely, and foundation comb is admitted under sworn certification that it was prepared from wax heated to a required extent. Yellow wax is heated after arrival, or excluded, unless it is likewise certified. The foundation comb admitted comprised 2,045 lb. in 29 lots; the white wax, 4,625 lb. in 46 lots; and the yellow wax only 4,666 lb. in 12 lots, against over 70,000 lb. in the previous year.

8. *In-transit Plant Inspections.*—The regulations remained unaltered, except that plants subject to them are now legally removed, only under special permit, into the Cape Province from any place in the other Provinces. As noted in previous reports, it is strongly suspected that the regulations are very commonly infringed without detection. The postal sendings examined totalled 284, and the railway consignments 330; 124 were fumigated. Many plants were found infested with one or another of 9 species of common scale insects, red scale predominating and being reported in 14 consignments. Pernicious scale was found on 4 lots of plants, 3 railway and 1 postal, at Pretoria; the infested plants comprised rose, Japanese quince, peach, and other fruit trees, and were returned to sender or destroyed. The Japanese quinces were intended for a Cape Province address. All the sendings of woody plants from Pretoria nurseries were specially inspected before dispatch, and fumigated under supervision, as a precaution against the spread of pernicious scale under special regulations, withdrawn when the new regulations for the protection of the Cape Province came into force. These operations consumed a large share of the local inspector's daily time, and were apart from the in-transit work.

During the year, the common lawn grass known as "Bradley" was discovered to suffer seriously from a gall-forming nematode, which Dr. N. A. Cobb of the U.S.A. Department of Agriculture proposed to describe under the name *Tylenchus tumefaciens.* The grass concerned is a *Cynodon*, perhaps *incompletus*, but its specific status is at present in doubt. A certain Johannesburg grass specialist was found to be inadvertently distributing the pest with grass. His lawns were placed in quarantine, and the plant inspectors now watch this grass closely; but it is improbable that the efforts of the Division to check the spread of the pest will be of much avail.

REPORT No. VI.—LOCUST ADMINISTRATION.

Officer in Charge: R. H. WILLIAMS.

1. *A Smaller Infested Area.*—There was a considerable change in the locality of the main centre of voetganger infestation during the past season from that of the previous one. In 1923-24 very intense and widespread outbreaks occurred in the eastern Cape Province and throughout the whole of the Orange Free State, whereas in these areas during the season under review, with the exception of the western portion of the Orange Free State, the infestation was very small. Even in the Transvaal, generally speaking, the infestation was considerably lighter.

There is no doubt that the campaign conducted in the Union, the accessible parts of the Bechuanaland Protectorate and South-West Africa during the 1923-24 season bore good results, and had the Union escaped the invasion of flying locusts from the innermost parts of the Kalahari, wherein under present conditions it is not possible to conduct a campaign, the hatchings in the Union during the past season would have been very small.

That the 1924-25 voetganger campaign was chiefly directed against the progeny of the locusts that flew into the Union from the Kalahari, is borne out by the fact that the heaviest infestation of voetgangers occurred in those portions of the Union affected by the invasion, viz., the north-western districts of the Cape, the northern districts of the Transvaal, and the eastern portion of the Bechuanaland Protectorate. It is not claimed that no swarms escaped destruction in the Union and reached the winged stage; they undoubtedly did, especially in the unoccupied portions of the north-western Cape districts, but the destruction of the progeny of these swarms alone, in 1924-25, would not have involved a very large campaign.

The heaviest infestation in the whole of the area affected by the locusts in South Africa (*vide* attached map) occurred in the Rustenburg District. This district received the full force of the Kalahari invasion of flying locusts, and to combat hatchings it was necessary to import labour and rush the men down into the bushveld by means of motor transport. As many as 2,300 sprayers and water-carriers were employed, and no less than 54,334 gallons of concentrated poison used in this district.

During the past season 550,000 gallons of concentrated poison were issued as compared with 556,776 gallons during the previous season. The dusting process was, however, resorted to on a much larger scale than previously, 75 tons of arsenite of soda powder being used in addition to the liquid poison. For the purpose of transporting water, over 6,000 (forty-gallon) water barrels were purchased.

The total number of swarms of voetgangers destroyed in the Union was 832,896 (for details see attached schedule) as compared

with 818,425 during the previous season. The small difference between the number of swarms destroyed during the two seasons, in spite of the fact that the infested area this season was much smaller than that of the previous season, is accounted for by the fact that the infestation was far more intense, in parts, than it had ever been before.

2. *Staff.*—As Mr. Graham Cross's duties as Under-Secretary for Lands did not permit him to continue to act as Chief Field Officer, Mr. Wilco Wilkens, who had had considerable experience in locust work in the capacity of a district locust officer, and occasionally as understudy to Mr. Cross, was appointed Chief Field Officer. The field staff employed in the Union consisted of 1 chief field officer, 16 senior locust officers, 191 district locust officers, and 1,565 local locust officers. In addition, over 17,000 sprayers and water-carriers were employed from time to time.

3. *Bechuanaland Protectorate.*—The campaign in this Protectorate was assisted to a large extent by the organization work the Kalahari Expedition was able to carry out during the course of its travels. This was particularly the case in respect of the verification of the report that a large deposit of eggs existed along the Botletle River. Immediately the first report of hatchings was received in respect of this area, a senior locust officer proceeded to the scene of the outbreak and remained on the spot until the last swarm was destroyed. The outbreak was a very large one and took six weeks to stamp out. The swarms destroyed in this one outbreak would, if they had been allowed to escape and reach the winged stage, have been sufficient to flood the northern Transvaal and Southern Rhodesia with locusts. The area infested being a malarial one, the work was to a large extent delayed in consequence of the occurrence of a great deal of sickness amongst the natives. The motor lorry sprays were used to great advantage on the extensive hatching that occurred in the Serowe District, northern Protectorate. The infestation in the southern portion of this territory was not so severe as in the northern portion. Very severe hatchings also occurred in the Ngamiland and Ghanzi Districts and in the latter part of the season in the Lehututu area. The main method of destruction employed in this area was the dusting process, camels being used for transporting the officers. In Ngamiland, a fungus (*Empusa grylli*) accounted for a large number of locusts, and it is confidently hoped that as a result no egg deposits remain in this area. Unless anything very unforeseen happens, it is expected that next season's hatchings in the Bechuanaland Protectorate will be confined to the southern portion, bordering on the Cape Province—a very difficult area in which to conduct a campaign. The total number of swarms (all of far larger dimensions than those to be found in the Union) destroyed in this Protectorate was 33,575 as compared with 42,777 during the previous season. The staff employed consisted of three senior locust officers and 109 locust officers assisted by the native tribes. As heretofore, several headman were trained to mix poison and, under the supervision of a European officer, were placed in charge of native spraying gangs. The native chiefs co-operated well with the locust officers and provided the necessary labour and transport.

This opportunity is taken of expressing appreciation of the assistance and support the Locust Administration received from His Honour the Resident Commissioner and his staff, more especially those magistrates and members of the Bechuanaland Protectorate Police stationed in the far outlying districts in which the campaign has to be carried on under very trying conditions. Great credit is due to Senior Locust Officer M. S. Grobler who, very ably supported by Messrs. J. Vine and P. A. Johnston, once again supervised the organization and operations in the Bechuanaland Protectorate.

4. *South-West Africa.*—With the exception of a few districts this territory was generally infested with locusts. Unfortunately, when the campaign was at its height the poison supplies failed owing to a washaway at Upington, the supplies being held up on the Union side of the Orange River for over six weeks. As soon as the state of the flooded river permitted, arrangements were made to get the poison across by means of small boats and rafts, the work being carried on throughout the night as well as the day. It was a slow process, but it was the only way in which the poison could be got over. Fortunately, a fungus (*Empusa grylli*) had spread in the meantime amongst the locusts in the northern districts and saved the situation to a certain extent. In the southern portion, however, the fungus was not prevalent, and owing to the operations being held up through the poison supplies becoming exhausted a large number of locusts reached the winged stage, with the result that a further heavy infestation will have to be dealt with during the forthcoming season.

During the course of last season's campaign in this territory 86,900 swarms of voetgangers were destroyed.

5. *Results and Prospects.*—Taking into consideration the extraordinary intensiveness of the outbreaks that occurred during the past season, especially in those parts of the Union affected by the invasion of flying locusts from the Kalahari in May and June of 1924, the fact that the Union has been able to produce and reap a record maize crop goes to prove that the money (approximately half a million pounds, which includes poison supplies valued at £100,000 on hand from the previous season) expended on the locust campaign was well invested and was the means of enabling hundreds of farmers to reap the full benefit of the very favourable climatic conditions that prevailed, and of saving the Union a loss of millions of pounds.

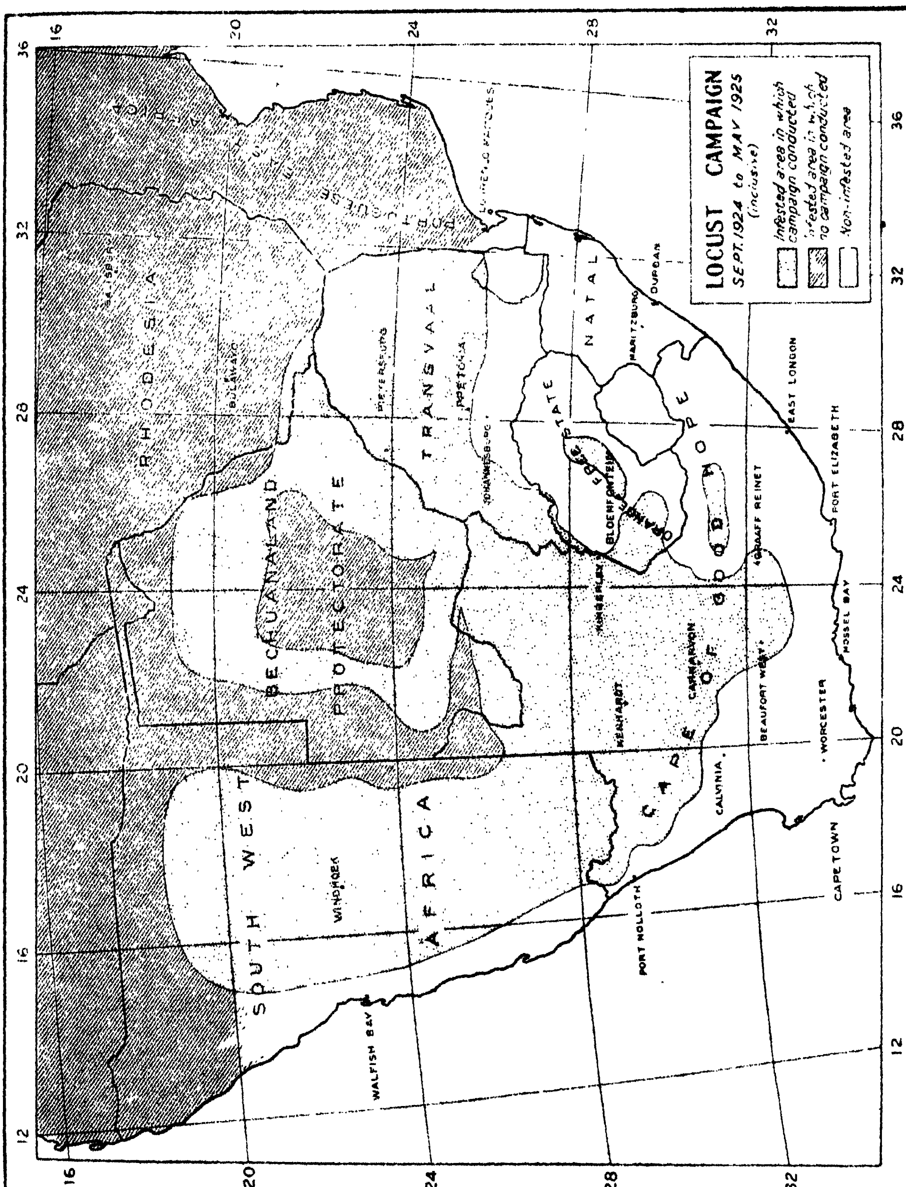
Much praise is due to the farmers, especially those resident in the stock-raising areas who, despite the fact that they have not so much at stake as those resident in the agricultural districts, with very few exceptions loyally supported the locust officers right throughout the campaign. The sacrifices that the farmer has to make in connexion with the destruction of locusts can be better appreciated when it is remembered that the hatchings occur concurrently with the ploughing season, with the result that a very large number of farmers have to neglect their ploughing in order to destroy the locusts.

The expenditure this season was considerably increased by the purchase and use of motor lorry sprays. These sprays more than paid for themselves in that they enabled the campaign to be carried to a much greater distance into the Kalahari than has hitherto been possible. In spite, however, of the use of the motor sprays, there

still remains a large tract of land where, although there is sufficient moisture to enable the locusts to hatch out and thrive, there is not sufficient water to enable a locust campaign to be conducted therein. It was the locusts from these parts that hatched out after the northern districts of the Cape had been cleared and flooded them again with flying locusts in May and June, 1925. In the case of these flying locusts the birds are, unfortunately, a drawback rather than an asset for, from information to hand, there is no doubt that the locusts that are hatched in the inner Kalahari and emigrate into the north-western districts, when attacked by the birds immediately double back towards the Kalahari. They seem to know that the birds will only follow them as long as water supplies last and that therefore the Kalahari is their refuge. This happened this season with the result that, unless the various natural enemies of the locust destroy the eggs, flying locusts may again be expected from the inner Kalahari next season.

The prospects for next season are, however, considerably brighter than they have ever been before during the present cycle. As a result of the past season's strenuous campaign the Transvaal, with the exception of a small area in the south-western portion, and the Orange Free State, with the exception of the Boshof, Jacobsdal, Koffiefontein, Fauresmith, and Philippolis Districts, are entirely free of egg deposits. The campaign in the Union will, therefore, be confined to the above-mentioned portions of the Transvaal and Orange Free State, the north-western districts of the Cape (which latter, being mostly Kalahari, is very difficult country in which to conduct a campaign) and a few districts in the Cape midlands. In the Bechuanaland Protectorate, thanks to the very successful campaign conducted in the Bamangwato Reserve, more especially along the Botletle River, the northern Protectorate is reported free of egg deposits. In Ngamiland and Ghanzi no hatchings are expected owing to the fungus having killed off the locusts. Next season's campaign in this territory will therefore be confined to the southern Protectorate bordering on the Cape Province. The method of attack on the locusts in this area, which is almost waterless, will be the dusting process (arsenite of soda powder). How far into the desert it will be possible to conduct the campaign depends on the success of the efforts the Locust Administration is at present making to sink a few wells and to preserve water in the pans for drinking purposes. In South-West Africa, next season's campaign, as a result of the inroads made by the fungus upon locusts in practically all the districts situated to the north of Windhoek, should be confined to the southern districts. The campaign in the whole of this territory is conducted under very trying conditions, lack of population and water being the two chief obstacles.

6. *Destruction of Flying Locusts.*—In view of the heavy expenditure that was incurred by the Government in protecting the farmers against the ravages of the voetgangers, and the fact that experience has proved that it is impossible to control efficiently the expenditure in connexion with the destruction of flying locusts, as the work can only be carried on during the night, it was decided that payment to farmers for this work was not justifiable. The Government, therefore, appealed to the farmers to co-operate with one another and destroy flying locusts voluntarily in return for the money expended on


LOCUST CAMPAIGN
SEPT. 1924 to MAY 1925
(inclusive)
Infested area in which campaign conducted
Infested area in which no campaign conducted
Non-infested area
RHODESIA
BECHUANALAND PROTECTORATE
SOUTH WEST AFRICA
TRANSVAAL
NATAL
ORANGE FREE STATE
CAPE OF GOOD HOPE
BULAWAYO
PIETERSBURG
PRETORIA
JOHANNESBURG
BLOEMFONTEIN
KIMBERLEY
MARITZBURG
DURBAN
EAST LONGON
PORT ELIZABETH
GRAAFF REINET
MOSSEL BAY
BEAUFORT WEST
WORCESTER
CAPE TOWN
CALVINIA
CARNARVON
KENHARDT
PORT NOLLOTH
WINDHOEK
WALFISH BAY

the destruction of voetgangers. The Government undertook to provide pumps and poison for the purpose and to take precautions along the Bechuanaland-Transvaal border against an invasion from the Kalahari. With this end in view the motor lorry sprays were concentrated along the border and excellent destruction work was carried out amongst flying locusts at night. Great credit is due to Senior Locust Officer Bezuidenhout, who superintended these operations, and the officers who worked under him.

7. *Methods of Destruction.*—Methods similar to those of previous seasons were adopted for destroying voetgangers, viz.: (*a*) Spraying with arsenite of soda solution, sweetened and unsweetened, by means of hand pumps, barrel pumps, and motor lorry sprays; (*b*) baiting; and (*c*) dry dusting, in which arsenite of soda in very fine powder form is used.

8. *Motor Lorry Sprays.*—So very intense was the infestation in certain unoccupied portions of the Union that it was decided to puchase a few motor lorries and equip them with spraying apparatus. Excellent results were obtained by means of these lorries, especially in connexion with the destruction of flying locusts. As next season's campaign will chiefly be confined to the large unoccupied areas in the north-western districts of the Cape, it has been decided to purchase and put into the field a few more motor lorry sprays. Motor lorry transport was also very largely used for conveying poison supplies to the depots far removed from the railhead.

9. *Boreholes.*—Arrangements were made with the Irrigation Department for five boreholes to be sunk on Crown lands in the Mafeking District and three in the Waterberg District. Without these boreholes a locust campaign in these parts would not have been possible. The Bechuanaland Farms, Limited, also very kindly came to the assistance of the Locust Administration and granted permission to its officers to use the boreholes situated on their farms in the vicinity of the Vryburg-Mafeking border.

10. *Aerodromes.*—Three aerodromes were prepared in the Kalahari portion of the Gordonia District. The position in these parts, however, did not justify the employment of aeroplanes, which it was intended should be utilized for the purpose of carrying and dropping supplies to the officers stationed in the Kalahari.

11. *Natural Enemies of the Locust.*—During the past season the greatest assistance received by the Locust Administration from the natural enemies of the locust was that rendered by a fungus (*Empusa grylli*) which developed in the northern districts of South-West Africa and spread into Ngamiland. This fungus grew and flourished as a result of the incessant rains that fell in these parts. The two flies (the fly that deposits a maggot at the back of the neck of the locust and the fly that deposits its eggs in the locust egg pockets) were fairly prevalent in parts. Locust birds were also prevalent, but in view of the previous remarks in respect of the birds, and for the further reason that, finding the sick locust easier to catch and discovering that the locust with the maggot in it has more relish than the healthy one, they eat the former in preference to the latter and thereby minimize the prevalence of the fly, it is believed that the assistance the birds are supposed to render is somewhat overestimated.

12. *Kalahari Expedition.*—The expedition left Pretoria on the 29th July, 1924, and returned at the end of October, 1924, after covering approximately 3,000 miles by motor, ox-wagon, and on foot, during the course of its travels. The members were Lt.-Col. G. N. Williams, D.S.O., Under-Secretary for Agriculture; C. W. Mally, Senior Entomologist; M. S. Grobler, Senior Locust Officer, Bechuanaland Protectorate; Lt. Tasker, South African Air Force; J. C. Bodenstein, Mechanical Engineer; and F. A. Begbie, Transvaal Agricultural Union.

The expedition reported that—

(1) it had collected ample evidence to dispose of the idea that any particular portion of the Kalahari was especially favoured by the locust as a breeding place;

(2) taking into consideration the heavy expense that a locust campaign in the interior of the desert would involve, owing to lack of roads and water, it did not advocate such a campaign but considered that a thorough trial of the cordon system along the borders of the desert should be attempted on as extensive a scale as possible;

(3) motor transport could be used to a very large extent in the desert;

(4) it was of vital importance that (*a*) every endeavour be made to destroy the flying swarms as they reached the eastern border; and (*b*) locust research work be commenced immediately.

These recommendations were approved and are being acted upon

The expedition carried out an air survey, and much valuable information as regards roads and methods of communication was collected and is available for use in the event of its being decided later that an extensive campaign in the desert must be embarked upon. The expedition also undertook organization work in the remoter parts of the Protectorate, which it had not been possible for the locust officers to visit, and obtained the co-operation and support of the leading native chiefs in these parts. Including the salaries of the permanent officials, the total cost of the expedition was approximately £1,600.

13. *Locust Research.*—A Locust Research Division has been formed, and under the guidance of Dr. C. W. Mally, Senior Entomologist, Division of Entomology, is now busy with its functions.

14. *Sale of Dried Locusts.*—Owing to the scarcity of flying locusts this season as compared with previous seasons, and to the fact that farmers and natives have learnt to appreciate the value of dried locusts as a food for stock and are therefore not so inclined to sell them as they previously were, very few locusts were sold this season.

15. *Comparative Return of Expenditure and Swarms Destroyed.*

Season.	Amount.	Swarms of Voetgangers destroyed.
1921-22	£45,855	118,662
1922-23	£58,221	242,166
1923-24	£324,726	961,202
1924-25	£377,214	953,371

It will be noticed that although the expenditure for 1924-25 is heavier than that of the previous season, the difference between the number of swarms destroyed during the two seasons is very small. The heavier expenditure in 1924-25 is due to the fact that, as the chief centres of infestation were in the extensive unoccupied waterless and outlying parts of the Union, very heavy expenditure in connexion with sprayers' and water-carriers' wages and the transport of material and labour was necessitated. The swarms in these parts were also, naturally, much larger than those that hatched out in the occupied portions of the Union.

16. *Adjoining Territory Infestation.*—Southern Rhodesia and Portuguese East Africa, which were both heavily infested, were reported free of locusts. The swarms which hatched in Southern Rhodesia were the progeny of the locusts that flew into that territory in May and June of 1924 from the N'kate in northern Bechuanaland Protectorate. During the past voetganger season, however, the Union Locust Administration was able to conduct the campaign in the northern Protectorate much farther inland, thus protecting Southern Rhodesia from a further invasion from these parts. Southern Rhodesia, having destroyed the hatchings of the earlier invasions referred to above, was later entirely free of locusts. The locusts that hatched out in Portuguese East Africa were the progeny of the locusts that flew into that territory from the eastern and northern Transvaal. When the hatchings commenced in this territory the authorities reported that the localities in which they had occurred were inaccessible and that it was impossible to conduct a campaign therein. These locusts therefore escaped destruction and flew back into the Union, mostly into the Sabie Game Reserve, where they were satisfactorily dealt with. The campaign in the Sabie Game Reserve, however, presented considerable difficulty, and the Locust Administration is much indebted to Major Hamilton, the warden, for the able and successful manner in which he organized and carried it through.

17. *Poisoning of Stock.*—In spite of the continual warnings and minute instructions of the Locust Administration in regard to the use of the poison, quite a large number of poisoning cases occurred; some were due to accidents but the majority were caused by carelessness and disregard of instructions.

18. *Prosecutions.*—It was found necessary to prosecute under the Locust Law in far fewer cases this season than last season. Only 39 prosecutions took place as compared with 381 during the previous season.

19. *Assistance from other Government Departments.*—The Locust Administration gratefully acknowledges the assistance again given by the Departments of Justice, Defence, Native Affairs, and Irrigation, the Railway Administration, the Controller of Transport, and the Superintendent of the Pretoria Government Garage.

District.	Number of Locust Officers.	Number of Sprayers and Water-carriers.	Number of Prosecutions.	Number of Swarms Destroyed.	Probable Extent of Next Season's Infestation.
Cape Province—					
Aberdeen	8	44	Nil	2,345	Slight.
Adelaide	1	Nil	Nil	40	Nil.
Aliwal North ...	1	Nil	Nil	39	Nil.
Barkly West ...	39	382	Nil	15,125	General.
Beaufort West ...	5	Nil	Nil	300	Slight.
Bedford	1	Nil	Nil	1,000	Nil.
Britstown	9	21	Nil	3,093	Heavy.
Burghersdorp ...	12	Nil	Nil	873	Nil.
Calvinia	19	Nil	Nil	940	Heavy in parts.
Carnarvon	11	2	Nil	519	Extensive.
Colesberg	10	4	Nil	580	Slight.
Cradock	7	Nil	Nil	160	Nil.
De Aar	6	Nil	Nil	980	Heavy.
Dordrecht	Nil	Nil	Nil	50	Nil.
Fraserburg	3	27	Nil	222	Serious.
Graaff-Reinet ...	3	7	Nil	1,000	Slight.
Gordonia	39	785	Nil	18,511	Heavy in parts.
Hanover	8	3	Nil	700	Slight.
Hay	43	381	Nil	13,416	Extensive.
Herbert	21	41	Nil	1,860	General.
Herschel	1	Nil	Nil	43	Nil.
Hopetown	21	Nil	Nil	20,579	General.
Jansenville	6	Nil	Nil	1,550	Nil.
Kenhardt	71	365	Nil	9,817	Heavy.
Kimberley	9	3	Nil	459	Severe.
Klipdam	16	76	Nil	2,032	Slight.
Kuruman	152	450	2	56,000	Heavy.
Lady Grey	1	Nil	Nil	10	Nil.
Laingsburg... ...	1	Nil	Nil	173	Heavy.
Mafeking	38	617	2	7,697	Heavy.
Maraisburg... ...	3	Nil	Nil	3	Slight.
Middelburg... ...	4	2	Nil	1,000	Slight.
Molteno	9	Nil	Nil	2,172	Nil.
Murraysburg ...	2	Nil	Nil	100	General.
Namaqualand ...	17	48	Nil	2,883	Heavy.
Pearston	3	Nil	Nil	550	Very slight.
Philipstown ...	6	20	Nil	803	Heavy.
Prieska	24	119	1	9,954	Very heavy.
Prince Albert ...	9	30	3	1,900	Heavy in parts.
Queenstown ...	1	Nil	Nil	3	Nil.
Somerset East ...	Nil	Nil	Nil	16	Nil.
Steynsburg... ...	6	Nil	Nil	Nil	Nil.
Steytlerville ...	4	Nil	Nil	512	Very slight.
Sutherland	Nil	Nil	Nil	Nil	Slight.
Tarkastad	Nil	Nil	Nil	Nil	Slight.
Taungs	18	128	Nil	6,669	Heavy.
Uitenhage	2	Nil	Nil	64	Nil.
Van Rhynsdorp ...	Nil	Nil	Nil	Nil	Heavy in Bushmanland portion.
Venterstad	4	Nil	Nil	70	Nil.
Victoria West ...	11	11	Nil	2,116	Heavy.
Vryburg	118	2,742	Nil	36,938	Very extensive.
Williston	3	Nil	Nil	105	General.
Willowmore ...	2	Nil	Nil	200	General.
	811	6,303	8	226,528	

District.	Number of Locust Officers.	Number of Sprayers and Water-carriers.	Number of Prosecutions.	Number of Swarms Destroyed.	Probable Extent of Next Season's Infestation.
Transvaal—					
Barberton	17	11	Nil	305	Nil.
Carolina	15	1	Nil	200	Nil.
Christiana	30	Nil	Nil	3,526	Slight.
Klerksdorp... ...	25	33	Nil	6,023	Nil.
Krugersdorp ...	15	9	Nil	3,016	Nil.
Lichtenburg ...	56	402	Nil	39,299	Slight.
Lydenburg	70	Nil	Nil	702	Nil.
Marico	48	1,006	Nil	58,641	Nil.
Middelburg ...	31	44	Nil	2,000	Nil.
Pietersburg... ...	35	531	Nil	43,145	Nil.
Potchefstroom ...	29	Nil	Nil	4,131	Nil.
Potgietersrust ...	32	1,297	Nil	108,495	Nil.
Pretoria	58	400	Nil	18,000	Nil.
Koster	22	Nil	Nil	3,525	Nil.
Rustenburg... ...	78	2,308	3	103,052	Nil.
Schweizer Reneke...	20	Nil	Nil	5,500	Nil.
Ventersdorp ...	35	Nil	Nil	10,000	Nil.
Vereeniging ...	15	Nil	Nil	304	Nil.
Waterberg	75	2,612	28	122,000	Nil.
Wolmaransstad ...	33	100	Nil	3,525	Nil.
Witbank	1	Nil	Nil	16	Nil.
Zoutpansberg ...	49	850	Nil	33,101	Nil.
	789	9,601	31	568,506	
Orange Free State—					
Bethulie	16	Nil	Nil	306	Nil.
Boshof	21	324	Nil	6,020	Slight.
Bothaville	8	1	Nil	793	Nil.
Brandfort	8	14	Nil	1,500	Nil.
Dewetsdorp ...	3	Nil	Nil	57	Nil.
Edenburg	4	Nil	Nil	261	Nil.
Fauresmith... ...	26	200	Nil	380	Slight.
Hoopstad	29	52	Nil	1,390	Nil.
Jacobsdal	2	Nil	Nil	167	Slight.
Koffiefontein ...	1	Nil	Nil	85	General.
Philippolis	15	Nil	Nil	5,500	Slight.
Rouxville	3	Nil	Nil	90	Nil.
Smithfield	4	Nil	Nil	156	Nil.
Thaba 'Nchu ...	3	Nil	Nil	448	Nil.
Vredefort	8	Nil	Nil	4,700	Nil.
Wepener	Nil	Nil	Nil	1	Nil.
Winburg	4	50	Nil	16,000	Nil.
Zastron	1	Nil	Nil	8	Nil.
	156	641	Nil	37,862	

Summary.

Province.	Number of Locust Officers Employed.	Number of Sprayers and Water-carriers.	Number of Prosecutions.	Number of Swarms of Voetgangers Destroyed.
Union of South Africa—				
Cape Province	811	6,303	8	226,528
Orange Free State ...	156	641	Nil	37,862
Transvaal...	789	9,604	31	568,506
Total	1,756	16,548	39	832,896
Bechuanaland Protectorate	112	Native labour by tribes	Nil	33,575
South-West Africa ...	398	200	Nil	86,900

REPORT No. VII.—CHEMISTRY.

Acting Chief of Division: DR. ST. C. O. SINCLAIR, M.A., F.I.C.

1. *Organization.*—During the year the Division performed chemical work—routine and investigational—for the several departments of the Union Government, with the exception of the Division of Veterinary Education and Research, which has its own chemical staff at Onderstepoort.

To carry out its functions the Division has (1) three series of laboratories—one at Pretoria, one at Johannesburg, and one at Cape Town; (2) a senior chemist, stationed at the Grootfontein School of Agriculture, Middelburg (Cape Province), who, in addition to his own staff, had the partial services of the chemical staff of the school and the use of the laboratory attached to that institution; (3) the partial services of the staffs of the chemistry sections of the five Schools of Agriculture.

As in the past, the chemical work of the Pretoria laboratory was wholly agricultural, and confined almost exclusively to research work. That of the Johannesburg laboratories, except for a measure of work under the provisions of the *Wine, Spirits, and Vinegar Act*, was entirely non-agricultural. The Cape Town laboratories carried out both agricultural and non-agricultural work, which was investigational as well as routine in character. The senior chemist at Grootfontein was specifically charged with the duty of directing the Union soil survey. As far as the Division was concerned, the work carried out by the chemical officers at the schools was, with the exception of Cedara and Elsenburg, entirely of an investigational nature. At the two schools mentioned a certain amount of routine work in connexion with the *Fertilizers, Farm Foods, Seeds, and Pest Remedies Act* was also performed.

2. *Staff.*—In order to enable the Division to cope to some extent with the constantly increasing work in connexion with the Union soil survey and irrigation schemes, two additional technical officers—Dr. M. M. S. du Toit, B.A., and Mr. F. E. A. Leibrandt, M.A.—were appointed during the year and stationed at the Grootfontein School of Agriculture under the control of the senior chemist there.

In March, 1925, the Chief of the Division, Dr. Chas. F. Juritz, M.A., F.I.C., retired on pension, and Dr. St. C. O. Sinclair was appointed Acting Chief. A biographical sketch of Dr. Juritz's career has already appeared in the columns of the Department's *Journal*, but it is fitting here to record an appreciation of the valuable services rendered by him to the Division in particular, and to the profession of chemistry in general. Consequent upon this retirement, a certain measure of reorganization of the Division was effected during the month of June, 1925. The office of the Chief of Division, which had hitherto been located in Cape Town, was

removed to Pretoria. Mr. Stead, M.Sc., F.I.C., the senior chemist at Grootfontein, and his staff were transferred to the Pretoria laboratory, Dr. B. de C. Marchand, B.A., till then senior chemist at Pretoria, being transferred to Cape Town as officer in charge of the Government Chemical Laboratories there.

Lieutenant-Colonel Rose, of the Cape Town staff of the Division, served on three committees appointed by the Department of Mines and Industries to investigate *(a)* the oil-fuel resources of the Union, *(b)* mechanical road transport, and *(c)* the purchase of Government supplies. Mr. B. J. Smit, chemist on the staff of the Pretoria laboratory, was appointed Secretary to the Organizing Committee constituted to deal with the cotton manurial experiments to be carried out at the instance of the British Empire Cotton Growing Corporation. Mr. W. J. Copenhagen, technical assistant at Cape Town laboratory, was seconded for six months to the Mines and Industries Department for service in connexion with the Union fishery survey.

3. *Research Work*: *(a) Soil Investigations.*—The agricultural soil survey of the Union has been continued as far as the limitations of staff have permitted, and some measure of progress was recorded. Much of the time of the officer in charge and his staff was taken up in carrying out investigations in connexion with the soil conditions of land coming under irrigation and land settlement schemes, and much useful work was done in this direction. The field work of the undermentioned preliminary soil surveys was carried out during the year: (1) The Doorn and Tanqua irrigation project, Ceres, Calvinia area; (2) Vaal Hartz irrigation project, Kimberley, Taungs area; (3) Lebombo Flats, Komatipoort scheme; (4) certain farms in the Maclear District.

In addition to these soil researches, other investigations into the physical and chemical properties of South African soils were conducted, the results of which will be published in due course.

(b) Soil Inoculation.—Experiments in soil inoculation were continued and the results duly published.

(c) Citrus Investigations.—The three phases of citrus culture under investigation, referred to in last year's report—namely, (1) citrus soils and their fertilization, (2) composition of citrus fruit at different stages of growth and in different parts of the country, and (3) effects of spraying citrus trees on the flavour of the fruit—have been continued, and a bulletin recording the results to date will appear shortly.

(d) Fruit Investigations.—Further investigations were made in connexion with the changes which take place in grapes on ripening, and preliminary inquiries into the effects of spraying upon the flavour of such fruits as pears, apricots, and apples were also commenced.

(e) Fumigation with Liquid Hydrocyanic Acid Gas.—In collaboration with the Division of Entomology, an investigation into the comparative efficacy of fumigation with liquid hydrocyanic acid gas was carried out. The results will be published in due course.

(f) Sulphuring of Dried Fruit.—In view of the proposal of the Imperial British Government to limit the permissible amount of sulphurous oxide in dried fruits, the extent to which this

preservative is made use of in South Africa was inquired into and a considerable number of analyses of dried fruit made. In conjunction with the Division of Field and Animal Husbandry, the whole matter of the sulphuring of dried fruit is about to be systematically investigated.

(*g*) *Phosphate Investigations.*—In view of the need of phosphatic fertilizers in South Africa and the great advantage that would accrue from the establishment here of a successful phosphate industry, a certain measure of investigation was carried out in connexion with the use of local products. The investigations are not sufficiently advanced to allow of any full publication of results, and the work is being continued.

(*h*) *Composition of South African Tanning Materials.*—A fair amount of work was done during the past year at the Cedara School of Agriculture on the composition of South African tanning materials, and it is hoped that the stage will soon be reached when a fairly comprehensive report on the whole investigation may be published.

(*i*) *Prickly Pear Investigations.*—The question of prickly pear eradication has received the attention of the Division, and the efficacy of more than one suggested preparation has been inquired into. Experience has shown the ordinary spiny variety of prickly pear to be possessed of much value as a fodder, especially in drought areas, and that whilst it is certainly to be considered a pest in some districts, in others the tendency is to regard it more and more as a valuable asset.

(*j*) *Cotton-growing Manurial Experiments.*—The Division is acting in concert with the British Empire Cotton Growing Corporation, the Divisions of Tobacco and Cotton and Field and Animal Husbandry, in investigating the whole matter of soils suitable for cotton growing and the fertilizers to be adopted to secure the best results. The experiments will extend over a period of years.

4. *Routine Work*: (*a*) *Agricultural.*—The Chief of the Division continued to control the chemical work necessary under the provisions of the *Fertilizers, Farm Foods, Seeds, and Pest Remedies Act.* During the year a total of 506 samples of fertilizers was dealt with: 259 samples of these were analysed at Cedara and 41 at Elsenburg. In connexion with the Wine Export Regulations, framed under the provisions of the *Agricultural Produce Export Act,* 186 samples of wine were analysed at Cape Town. In no case was an adverse report submitted. Under the *Dairy Industry Act* several samples of butter were analysed in the Government Chemical Laboratories at Cape Town and the existence of a certain measure of adulteration disclosed. In addition to this work, standardization of dairy glassware was also carried out by the Division. For the purposes of the *Wine, Spirits, and Vinegar Act,* 658 samples of wines, spirits, and vinegar were analysed. The work was confined to the Johannesburg and Cape Town laboratories of the Division.

(*b*) *Public Health Work.*—In connexion with the food and drugs legislation operative in the four Provinces of the Union, 3,082 samples of foodstuffs were analysed. Of this number, 2,021 were samples of fresh milk. Analyses of potable waters were also

carried out, as well as certain analyses required under the provisions of the *Medical, Dental, and Pharmacy Act*. The preparation and supply of the mixed ethyl esters of Chaulmoogra oil used in the treatment of leprosy was continued in the Cape Town laboratory.

(*c*) *Customs and Excise Work*.—The work under this head consisted mainly of (1) analyses of miscellaneous articles for tariff classification; (2) analyses of medicinal, pharmaceutical, and toilet preparations for excise purposes. The total number of samples dealt with by the Division was 1,904.

(*d*) *Forensic Work*.—Toxicological and forensic work for the Department of Justice was undertaken in the Johannesburg and Cape Town laboratories; the first-named institution carried out the major portion of the work. The total number of specimens dealt with was 920. The number of attendances by members of the staff at courts of law was 164, the number of days involved in such attendances being 245.

(*e*) *Miscellaneous Work*.—The Division also carried out analyses for the South African Railways and Harbours Administration, Mines and Industries, and other Government Departments, as well as for the Administrations of South-West Africa, Basutoland, Bechuanaland, and Swaziland. Work was also undertaken on behalf of sundry municipalities and to some extent also for private individuals, the latter being performed in the special and limited circumstances prescribed in the Government Notices laying down the conditions under which such work is accepted.

5. *Publications*.—The Division's publications during the year, a list of which is appended, numbered 22. In addition to these, contributions were made to the public Press.

EXTRACTS FROM REPORTS OF THE DIVISION'S OFFICERS IN CHARGE AT JOHANNESBURG, CAPE TOWN, PRETORIA, AND MIDDELBURG (CAPE).

Johannesburg: *J. McCrae, Ph.D., F.I.C., Assistant Chief of Division*.—The aggregate number of samples examined during the year was 5,143, including 239 samples of gold and gold-bearing materials, 1,475 food samples, 586 wines and spirits and vinegars, 273 explosives, 342 leathers and leather preparations, 267 waters and 98 samples of liquor in connexion with illicit liquor selling cases, 246 drugs and medicines, and 305 exhibits in cases of human and animal poisonings.

Cape Town: *B. de C. Marchand, B.A., D.Sc., Senior Chemist*.—The total number of samples dealt with was 3,365. These included 1,753 examined under the provisions of the *Sale of Food and Drugs Act (Cape)*; 803 for the Department of Agriculture, consisting mainly of fertilizers, wines, spirituous liquors, and vinegars; and 431 for the Customs and Excise Department, comprising analyses of leathers and other articles for tariff classification, as well as that of spirituous preparations—medicinal, pharmaceutical, and toilet—for excise purposes. The research work of the laboratories included the investigations relating to the composition of citrus and other fruits, the composition of South African honey, and the effect of Cape Town water on locomotive boilers.

Grootfontein: *A. Stead, M.Sc., F.I.C., Senior Chemist.*—During the year, 622 written communications were received and 453 dispatched over and above the correspondence dealt with on behalf of the School of Agriculture. Work in connexion with the Union soil survey as well as various irrigation projects was carried out, and several lectures given at farmers' association meetings and farmers' weeks on soil problems connected with irrigation, veld improvement, animal nutrition, etc. It is worthy of record that the saaidam terrace system inquired into by the Senior Chemist has now been recommended to farmers not only as an agricultural resource, but as a means of minimizing the silt problem in dams.

Pretoria: *A. Stead, M.Sc., F.I.C., Senior Chemist.*—During the year, 235 samples were examined, 166 of which represent soil samples taken in connexion with various investigations. The research work carried out in the Institution included (1) the determination of the effects of varying quantities of water on the growth of oats in two widely differing types of soil, (2) an investigation into the composition of the fractions separated by mechanical analysis from some Transvaal soils, and (3) percolation experiments with black turf soil, using solutions of calcium nitrate of varying strengths. A large number of freezing-point determinations were also made in connexion with an inquiry into the alterations of the freezing point brought about by successive freezing of soil and the addition of certain substances. Standardization of dairy glassware was also undertaken, the total number of pieces dealt with being 1,390.

LIST OF PUBLICATIONS, 1924-1925.

DIVISION OF CHEMISTRY SERIES.

No. 24. T. D. Hall: "Nitrification in some South African Soils," Part II. (*Soil Science*, Vol. XVIII, September, 1924.)

" 25. T. D. Hall and J. C. Vogel: "Reversion of Acid Phosphates in Acid Soils." (*Soil Science*, Vol. XV, May, 1923.)

" 31. P. R. v. d. R. Copeman: "An Investigation into some Physical and Chemical Changes occurring in Grapes during Ripening." (Science Bulletin No. 30.)

" 36. B. de C. Marchand: "Representative Transvaal Soils." (*Journal of Agriculture*, July, 1924.)

" 38. T. D. Hall and J. C. Vogel: "The Influence of the Admixture of Different Grades of Limestone on the Solubility of Phosphoric Oxide in Superphosphate." (*Journal of South African Chemical Institute*, July, 1924.)

" 40. B. de C. Marchand: "The Colouring Matter in *Polysaccum crassipes* D.C." (*Journal of South African Chemical Institute*, July, 1924.)

" 41. D. J. R. van Wijk: "The Seasonal Variation of Nitrates in the Black Turf at Onderstepoort." (*Journal of the South African Chemical Institute*, July, 1924.)

" 42. J. J. Theron and J. V. Cutler: "Note on the Use of Waste Alcohol in the Calibration of Babcock Milk and Cream Test Bottles." (*Journal of the South African Chemical Institute*, July, 1924.)

" 43. C. O. Williams: "Manures and Farm Foods: Their Composition and Valuation." (*Journal of the Department of Agriculture*, September, 1924.)

" 44. W. Torrance: "Some Metamorphic Mudstones." (*South African Journal of Science*, Vol. XXI, November, 1924.)

No. 46. C. R. van der Merwe: "On the Formation of Soil from Diabase in the Central Transvaal." (*South African Journal of Science*, Vol. XXI, November, 1924.)

,, 47. B. de C. Marchand: "The Origin of Black Turf Soils in the Transvaal." (*South African Journal of Science*, Vol. XXI, November, 1924.)

,, 48. A. Stead: "Saaidam Terraces in the Karroo." (*South African Journal of Science*, Vol. XXI, November, 1924.)

,, 49. J. V. Cutler: "On the Nicotine and Ash Constituents of the Leaf of the Tobacco Plants grown in the Fertilizer Plots at the Rustenburg Tobacco and Cotton Experiment Station, Season 1921–22." (*South African Journal of Science*, Vol. XXI, November, 1924.)

,, 50. J. J. Theron and J. V. Cutler: "A Contribution to our Knowledge of the Function of Nicotine in the Tobacco Plant." (*South African Journal of Science*, November, 1924.)

,, 51. T. D. Hall: "Profitable Potato Production." (Department of Agriculture Science Bulletin No. 35.)

,, 52. C. F. Juritz: "Report of the Division of Chemistry for the Year ended 30th June, 1924." (*Journal of the Department of Agriculture*, December, 1924.)

,, 53. A. Stead: "Some Experiments on the Solubility of Saldanha and Grahamstown Phosphates in the Soil." (Department of Agriculture Science Bulletin No. 36.)

,, 54. C. F. Juritz: "Additional Notes on the Active Principles of South African Plants." (*Chemical News*, London, April, 1925.)

,, 55. F. Fevrier: "Comparative Results of Analyses of Spirits and Brandies." (Department of Agriculture Science Bulletin No. 37.)

,, 57. J. Moir and J. Lewis: "More Notes on Acocantherine." (*Journal of the South African Chemical Institute*, January, 1925.)

,, 59. C. F. Juritz: "The Problem of Noors Honey." (*Journal of the Department of Agriculture*, April, 1925.)

REPORT No. VIII.—EXTENSION.

Chief of Division: H. S. DU TOIT, M.Sc.

1. *Extension Work.*—Since April, 1924, but more especially during the first six months of 1925, the Division, short staffed as it was, was strained to its utmost capacity in meeting the multitudinous calls made upon it for lecturers and demonstrators at farmers' "weeks" and "days," and for judges and lecturers at agricultural shows.

The number of farmers' "weeks" and "days" and farmers' meetings for which lecturers were provided during the period April, 1924, to June, 1925, totalled 120; and for the agricultural and other shows approximately 130.

2. *Extension Officers (District Agents).*—In the early part of 1925 eight extension officers, including one senior officer, were appointed and allotted certain areas throughout the Union with temporary headquarters at more or less centrally situated places. These officers, although severely hadicapped by the enormous size of the areas in which they operate, and notwithstanding the many difficulties and hardships encountered during the rainy season of 1925, have been able to accomplish a great deal in giving practical advice and demonstrations to farmers, lecturing at meetings, and generally helping the rural population in organizing local extension committees, extension tours, farmers' weeks, etc.

To the field staff of the Division was also added a special organizing officer, while the Home Economics officers of the Department have been brought under the control of the Division.

3. *Agricultural Demonstration Train.*—Prior to April, 1924, the train made two tours in the Cape Province, mention of which was made in the last Annual Report of the Division. Subsequently the undermentioned tours were undertaken:—Tour No. 3 was a short one, commencing at Fauresmith and ending at Kopjes. Tour No. 4 was in the Western Transvaal, commencing at Krugersdorp and proceeding on the Pudimoe line as far as Kimberley; it ended at Potchefstroom on the return journey. Tour No. 5 was in Natal; and Tour No. 6, completed on the 9th August, was in the Northern Transvaal, proceding as far north as Louis Trichardt and Waterpoort with a deviation to a portion of the low veld (Tzaneen and Duivelskloof).

The next Tour (No. 7) contemplated will be through portions of the high veld and low veld. Tentative itineraries of tours for the next twelve months, i.e. in respect of portions of the Union which have so far not been visited, have been drawn up and forwarded to the farmers' associations concerned, agricultural schools, etc., for confirmation or amendment, as the case may be.

The tours accomplished by the train have produced splendid results. It may therefore be safely predicted that the future of the train, as a medium for disseminating agricultural knowledge, is assured.

Domestic Science.—The position as regards domestic science officers remains unsatisfactory. During the past year there were four such officers on the staff, two of whom will shortly leave the service. With such a limited number of officers it is impossible to carry out the work satisfactorily. The work comprises: judging at shows; short-courses lectures at schools of agriculture; demonstration train; extra-mural courses; farmers' days; experimental, practical, and office work. The demonstration train requires the services of one officer exclusively, with the result that a great many inquiries cannot be attended to, which is sometimes very disappointing to the farming community. One of the most important matters, the organization of our short courses at various centres, is at the moment totally neglected owing to shortage of staff.

The large area assigned to each of the domestic science officers causes waste, both of money and time, for extensive travelling has to be done to reach certain localities. The result is that fewer lectures and demonstrations are given per individual officer than would be the case if more such officers were available.

The work performed is of much value to farmers' wives and is greatly appreciated by them; for that reason it is necessary to carry on the work systematically and to act in accordance with a carefully planned policy. The present state of affairs leads to the dislocation of any system, besides creating a spirit of irresponsibility amongst domestic science officers. Complaints are being received from the public that at times correspondence has to await disposal for weeks, which is not conducive to the prestige of the Division.

REPORT No. IX.—DIVISION OF AGRICULTURAL ECONOMICS, MARKETS, AND CO-OPERATION.

Chief of Division: F. E. GELDENHUYS, B.A., B.Sc., Ph.D.

1. *The New Division and its Duties.*—The Division of Agricultural Economics, Markets, and Co-operation came into being early in 1925, and the already existing activities in connexion with the monthly crop and market report and co-operation were transferred to the new Division. The problem of every farmer, and of the Department of State responsible for furthering the business interests of the farmer, is to determine how the different factors of production can be made more effective. To do so, it is necessary to ascertain the efficiency of these factors on every farm and in every part of the country.

To determine this, investigation must be made into the management of the farm, the marketing of produce, and the organization of producers, middlemen, and consumers. Any shortcomings or difficulties in these respects must then be removed by means of education.

The wide extent and comprehensiveness of the field to be explored is shown in the organization and working of the Bureau of Agricultural Economics and Markets in the Department of Agriculture of the United States of America. South Africa has not the same conditions, population, and wealth that the United States has, and although similar investigation, education, and guidance are necessary here, this work, naturally, cannot be done on the same extensive and comprehensive scale as in the United States.

It is, however, necessary to begin upon the performance of certain essential ground work extending in every possible direction, since the absence of investigation in one particular direction may, to a large extent, negative the results achieved in another.

The activities of the Division can be grouped under the following four heads: administration, investigation, education, and extension.

The main aspect of the Division's duties, apart from administration, are those of (*a*) farm management and general economic questions; (*b*) marketing; and (*c*) co-operation; in respect of each of which investigation, education, and extension are necessary.

Each of the above sections has sub-divisions, such as, amongst others, the following:—

(*a*) *Farm Management and General Economic Questions*:

(i) Nature and types of South African farming in the different parts of the country in respect of the property of 90,000 white farmers.

(ii) Physical factors on farms and the various forms of land tenure—ownership, lease system, and so on.

(iii) Expenses, income, profits or losses in connexion with farming in different parts of the country, which will show—

(iv) cost of production, in different areas of the country, of various agricultural products, such as vegetables, fruit, grain (wheat, mealies, etc.), poultry and poultry products, pigs and their products, sheep and wool, cattle and dairy produce, and so on.

(v) Nature of labour and labour requirements of farms.

(vi) Capital conditions and capital requirements of farms.

(vii) Other economic questions, such as transport, etc.

(*b*) *Marketing*:

(i) Conditions at existing municipal markets in the large and other centres of the four Provinces. (There are about a dozen large markets, but nearly every small village has its own municipal market.)

(ii) Other marketing organizations, companies, exchanges, agents, and so on.

(iii) Markets in other parts of Africa.

(iv) Markets for our mealies, fruit, eggs, meat, etc., in Europe and other parts of the world.

For each of our important products, such as vegetables, grain, fruit, poultry, pigs, sheep and wool, cattle and dairy produce, there are differing market processes, and each product has its own peculiar features and difficulties in connexion with its collection, grading and standardization, packing, storage, transport, financing, risks, sale, distribution, information, propaganda, and advertising.

(*c*) *Co-operation*:

(i) Its necessity, underlying principles and methods; investigation; education; organization; and advice in connexion with the various products enumerated above.

(ii) Formation of co-operative societies, including framing of regulations, development of business, ensuring proper management, etc.

(iii) Sound development of co-operative societies, to secure which legislation, regulations, inspections, guidance, and assistance will, amongst other things, be necessary.

(iv) A study of social conditions generally prevailing on farms as a foundation for the development of co-operative undertakings and scientific methods.

Farmers in South Africa to-day probably suffer more loss through bad management and bad business methods than through wrong or faulty methods of production, and field and animal husbandry generally. How many farmers lay out their farms so as to secure the greatest possible economy in labour, and arrange the work so as to ensure the fullest possible employment of it throughout the year? How many farmers know anything about the cost of production? How many can keep books, without which production costs, payments, receipts, and profit and loss cannot properly be determined? How many know what actually happens to their produce in the process of marketing? How many have a proper conception of the principles and methods of co-operation? The management and business aspects of farming have hitherto been neglected, and there is need of much development in this direction.

2. *Production Costs and Economic Conditions.*—Another urgent matter is the study of farming conditions, more especially of the arrangement of the farming, the kind of farming suitable to certain areas, the size of the farm, the profits from farming, costs of production, etc. Very little work along these lines has been done in South Africa. Mr. E. Parish of the Glen School of Agriculture, in his investigations regarding the cost of mealie production, has done most in this direction. Before the establishment of this Division, Mr. A. P. van der Post, who is now in its service, had made certain investigations on the Indwe Settlement. On behalf of the Minister of Lands, he investigated, during the months of January to May, 1925, the economic conditions on the high veld settlements, and embodied his findings in an exhaustive report.

In the early part of 1925 a provisional investigation was made by Dr. Carel Potgieter into the costs of production of wheat in the Districts of Malmesbury, Piquetberg, Moorreesburg, Caledon, Bredasdorp, Swellendam, Ladybrand, Thaba 'Nchu, and Wepener, and facilities should be provided for carrying this investigation further.

As soon as staff is available it is hoped to begin upon the work of obtaining the necessary data on which to base advice to farmers in regard to the economic side of production.

3. *The Crops and Markets Sub-section.*—When this Division started to function in February, 1925, there was no authentic information available in regard to the working of, or the real conditions prevailing on, the various markets of the Union. In the past no systematic attention was paid to this very important factor in the process of production, and, when everything is taken into consideration, it is not surprising that there was a total lack of knowledge of the various systems and methods of marketing produce. Here also the Division had to start building and organizing from the foundation.

The first step was to gather information as to the true state of affairs. This was done (*a*) by circularizing all market masters in the Union, and thereafter (*b*) by visiting the principal markets.

Market masters were asked for information more particularly on the following three points: (*a*) Existing facilities; (*b*) improvements that might possibly be made; and (*c*) difficulties experienced locally which impede efficient marketing in general.

Most of the market masters supplied the desired information. Representatives of the Division personally visited the markets at Cape Town, Port Elizabeth, East London, Bloemfontein, Johannesburg, Durban, Pietermaritzburg, and Pretoria. Here investigations were made as to the system of marketing, the conditions under which marketing takes place, and the manner in which the various products are brought to market.

Conditions were found that, in more than one respect, were a veritable "eye-opener." There was revealed, in short, a total lack of knowledge of the elementary principles of a sound system of marketing, an almost total absence of organization among consumers and producers (the two parties for whose benefit public markets should really exist), and almost total absence of standardization and grading of the produce marketed; with one or two exceptions an excessive number of middlemen operating on the market; and, although the need therefor is generally recognized, a total absence

of channels to provide producers with necessary information on market prices and tendencies at the different centres.

As a result, it was decided that the first duty of the Division was educative work, not only amongst producers, but also amongst those responsible for the efficient organization of the markets. The former must, in particular, be roused to pay attention to the following four requirements in the efficient marketing of any product, namely: to bring every product to the *right* market, at the *right* time, in the *right* form of attractiveness, and in the *right* quantity. Closely connected with these are questions of cold storage facilities, financing of produce delivered, insurance, transport, etc., each of which is a problem in itself. Those who undertake to organize a public market should understand that the sole object of a market is to bring producers and consumers together in the most efficient manner. The working costs of every such undertaking should, therefore, be on as economical a basis as possible. The use of a market organization to bring in funds for other purposes is to be strongly deprecated. The Division is at present handicapped by the fact that although one of its functions is to guide and assist the farmer in the marketing of his produce, it has in reality very little power to guide things in the right direction. This applies particularly to the general methods of management observed in the different markets. The markets are controlled and managed by the market committee of each municipality. All regulations in this connexion are, after approval by the municipality concerned, subject only to the approval or otherwise of the Provincial authorities. A change in this respect is urgently needed in order to secure for the Division, which exists primarily for the purpose of safeguarding the interests both of producers and consumers, at least some part in the approval or rejection of market regulations, and the further right to inspect at any time any undesirable conditions prevailing at any of the markets.

A general state of indifference and lukewarmness is, however, discernible in regard to these questions vital to the majority of producers and consumers. With a view, therefore, to stimulating general public interest in this matter, and in an effort to place the true state of affairs before the people, the Division has decided in the first place to publish, in pamphlet form, all the data that have so far come under its notice. Until such general knowledge has been disseminated and interest therein kindled, all efforts at reform will be defeated.

In the second place, the Division is busily engaged upon the organization of a special marketing congress through the medium of which it is hoped to bring prominently before the notice of all concerned the urgent requirements of our marketing system. It is hoped also to lay down a basis for the development throughout the Union of a more uniform and efficient system.

In the third place, a special market intelligence service has been organized in conjunction with the postal authorities. This service has for its object the daily dissemination to every corner of the Union of advice concerning current market prices and tendencies, both inland and oversea. This will be done by telegram, telephone, and wireless. It cannot be expected that this service will in its early stages be as efficient and complete as it is hoped to make it; but it is a very important step in the right direction to place our farmers on an equal footing with speculators and middlemen, who

usually have a very effective intelligence service at their disposal. It is hoped that both producers and consumers will make full and intelligent use of the service.

A further duty will be the answering of inquiries as to market conditions, both in the Union and oversea. Then, also, care must be taken that all newspapers and periodicals are carefully scanned for the purpose of keeping in touch with the general trend of economic conditions; of being able to contradict less accurate information; and, further, of giving regular publicity to questions upon which the public should be kept informed.

4. *Crop Estimates and Reports.*—The crop reports section, which has formed a part of the Department since 1916, was also taken over by this Division. In the past excellent service has undoubtedly been rendered throughout the Union by the crop reporters, and a foundation has been laid on which it is possible to build in the future.

In any criticism of the work hitherto done in this connexion it must be remembered that a system of crop reports was in itself something altogether new to the South African farmer. The farmer had not only to be enlightened as to the methods of making the necessary estimates, but it was particularly difficult to convince him of the importance, not only to himself, but also to the public in general, of being in possession of accurate information of this nature.

Even now the necessity of giving accurate information is not fully realized by the great majority of farmers. It is still necessary constantly to devote much time in explaining the method of crop reporting. Calculations continue to be retarded because crop reporters fail to realize the importance of posting their cards punctually every month. Other difficulties also, amongst which lack of interest is prominent, are constantly occurring and handicap the efficiency of this information service.

The difficulties of framing a reliable crop estimate came particularly to the fore in connexion with the estimate of the record mealie crop this year. If it had not been for various other methods adopted by the crop section to obtain the necessary information, the estimates, on the basis of the data furnished by the crop reporters, would have been hopelessly wrong. The time has arrived when we should, in this respect, follow the example of other countries where special persons are appointed to go personally from district to district and draw up estimates of the crops. This system would not dispense with our corps of voluntary crop reporters; on the contrary, it would be the duty of these departmental itinerary crop reporters to improve the organization and, if possible, double the number of reporters, and to serve them with advice and guidance in the performance of their duties.

Steps were immediately set on foot for the reorganization of this section on the basis of the existing system, in the hope of making it more efficient and of more value to all concerned, as the information and statistics gathered by it are of the greatest importance. The interpretation of agricultural statistics is most closely bound up with the marketing of farm produce.

It is the intention that this section shall furnish the whole Department with statistical data. In this connexion there is

published a monthly "Crop and Market Report," which contains all information as supplied by the reporters in regard to estimated areas under cultivation and probable yield of crops throughout the Union, as well as information in regard to world crops, local and overseas markets, transport and trade reports, and other information of economic value. The object is to make this publication increasingly useful both to the farming and business sections of the community.

An urgent appeal is, therefore, again made to all concerned to contribute their share towards making this service as efficient as possible. It is particularly necessary that the number of crop reporters be doubled, and that the small attention and accurate service required of them should be carried out promptly. The services required are entirely voluntary, but we are convinced that once the importance and usefulness of this system are thoroughly understood, there will be no want of willingness on the part of farmers to co-operate with this Division in the matter.

5. *Sub-division of Co-operation.*—One of the most important functions of the Division will be to teach farmers, as well as the general public, what co-operation really is, a great lack of knowledge about the principles of co-operation being sorely evident. But if the Division is to be of the greatest use in this respect, it must have knowledge of the difficulties that co-operative societies have had to face in the past. It is therefore intended to begin a comprehensive investigation into the present state of co-operation in the country, the first steps having been taken in June, when visits to various co-operative societies representative of different branches of farming were paid. By the end of that month some seven co-operative societies had been visited, representative of dairy cattle breeding, egg-circles, general (mostly mealie) co-operative societies, fruit societies, and co-operative creameries. The intention is to continue the investigation during the coming year

It is, however, further necessary to consider the following questions if we are to understand the difficulties, limitations, requirements, and methods of co-operation: Is co-operation justified? What is the object of co-operation? What are the means of making a success of co-operation? How will it be possible to make a greater success of co-operation? What are the functions of a sub-division of co-operation? How are such functions being fulfilled to-day, and what are its shortcomings? What steps and organization are required to ensure a greater measure of efficiency?

(*a*) *Is co-operation or joint action justified in the business of farming?* The farmer produces articles which must be sold in order to satisfy wants, which his produce cannot directly satisfy; other people, however, want these products in order to satisfy their requirements, and there is thus created a certain supply of a commodity and a certain demand for it, and the price which will bring about an exchange depends on the quantity of such commodity, its quality, the manner in which it is offered, the place and time of offering, the cost of production, conveyance, and sale; the conditions, such as trade monopoly, under which the product is sold, and so on. To market a product properly, services have to be rendered for collecting,

grading, packing, storage, conveyance, risks, sale, and distribution, and the more persons that have to be paid therefor, and the more competition and manipulation thereof, the higher will be the price to the consumer, and the smaller the profit for the producer. If producers of a certain product jointly perform the service of marketing it the total cost for these services is reduced, and a portion of the cost, which would otherwise have fallen into the pockets of the middleman, will come to the producers. The marketing of the product can, in the first instance, be controlled in the interests of the producers, and an unnecessary multiplication of labour, expense, and separate profits avoided. According to the proportion of those who render marketing services coming into the employ of the producers, can supply and demand be controlled, savings be effected, and more profits reach the pockets of the producers. The great solution of the difficulties experienced by farmers in securing the advancement of their welfare, lies in standing together, planning together, working together, and sharing the profits together.

(b) *What is the object of co-operation?* The object is to make the marketing of produce as efficient as possible, to enable producers to reduce the costs of marketing to a minimum, and to obtain the maximum profits.

(c) *What means are to be employed to make a success of co-operation?* These are: Knowledge of the objects, principles, and methods of co-operation; knowledge of business principles; creation of the spirit and custom of working together; creation of favourable conditions for working together; provision of efficient guidance, information, regulation, inspection, and so on, in connexion with co-operation; and the provision of machinery suitable to the efficient and practical application of co-operative business principles.

(d) *How can co-operation be made more successful in South Afrcia?* By seeing that the above-mentioned means are put into practical operation, and by effective guidance, dissemination of knowledge and control.

6. *The Functions of the Division.*—To sum up, the functions of the Division of Economics, Markets, and Co-operation are: To place the business of farming on a sound and profitable basis, and to provide such guidance, dissemination of knowledge and control that agricultural co-operation (or business) organizations will be efficient and profitable and that the right ideas and spirit may prevail, a sound organization be formed and maintained, and effective methods applied.

Unless the Division advertises the principles and methods of co-operation as widely as possible, disseminates the knowledge thereof, urges the necessity therefor, and ensures the correct application of its principles by means of legislation, inspection, assistance, and organization, and so forth, it will fall short of its purpose and

possibilities, and the development of a profitable farming business, and effective co-operation in South Africa will, in consequence, remain for many years in a deplorably poor condition.

Hereunder is published the report of the Registrar of Co-operative Societies.

CO-OPERATION.

Registrar of Co-operative Societies: JOHS. RETIEF.

1. *Extension of Movement.*—The work of this sub-division is to assist and promote co-operation among farmers. Co-operation aims at the betterment of agricultural conditions by securing for farmers a reasonably profitable life. The prime cause of agricultural depression is competition in the food markets, and since successful competition is largely a question of business organization, of the adoption of such methods as meet the conditions of modern marketing, farmers can only obtain the best results by acting in combination, in other words by co-operation. In agriculture, combination, to improve methods and to effect economies, is as necessary for success as it is in commerce and manufacture. The isolated producer cannot approach the world markets, he cannot compete with the great agricultural countries which are organized to turn out their produce in the best condition at the best cost. He is therefore dependent on the middleman who mulcts him of profits at both ends of his business—in buying his requirements and in selling his produce. Efficiency on the commercial side is as necessary as in the methods of production. But, while the advance of the co-operative movement has been most gratifying and indeed beyond expectation, it is still the practice of some farmers to assist in beating down the price of their produce by dumping it on the market, in competition with their neighbours, soon after it is reaped. A section still buy their requirements by retail from the country storekeeper and sell their products to him at wholesale prices at the time most profitable to him. These methods are to some extent due to the farmer's need of credit to produce his annual crop, and a more general adoption of co-operative methods is looked to when the Government's agricultural credit scheme comes into operation. That rapid progress has already been made will be apparent from the fact that 277 organizations are registered at the time of writing, and 182 of these were formed after the *Co-operative Act* was passed in August, 1922. Many farmers have, however, still to learn that, by joining with their fellows to do their business well and economically, they are not losing their independence, but are gaining it. Until they take this common-sense view, and are determined to help themselves, and to take control of their own industry as their competitors in the markets of the world have done, they are not ready for co-operation.

This sub-division of the Department can assist organization greatly, but the success of co-operation depends on the loyal united efforts of its members; and while compulsory co-operation may be necessary in some circumstances to protect the existence of an industry, the value of a general application of the principle such as is to be found in Queensland can be doubted. There is always a certain distrust of new movements, and people are naturally shy of sharing the management of their affairs with others. A great deal of prejudice has been caused, too, by the failure in the very early days of the movement of certain associations, which as a result of grossly bad management failed to achieve their object. But these handicaps to voluntary co-operation are rapidly being overcome. The far-reaching insistence of the existing co-operative legislation on sound principles and safe methods is gaining support. In the present stage of development the great need of the moment is to guard against the pernicious influence of failures. Not only must the active societies be closely supervised, but it is the duty of the Registrar to refuse registration to any prematurely formed organization which, through lack of capital or support or other essentials to success, has little prospect of providing valuable service. On the other hand, the sub-division most gladly assists in every way possible whenever groups of farmers are ready to organize on a sound basis. Whenever possible it sends an official to address public meetings to promote formation and to explain the whole system. It undertakes all legal work involved, prepares and explains articles of association, and generally smooths the way to registration. At a later stage it supplies all necessary advice in regard to the accounting system and the general administration of the business. It is looked to for guidance in all difficulties. A considerable volume of work is dealt with in this connexion.

An important function of the sub-division is the supervision of registered associations. Experience has proved that to protect the smooth development of the movement against failures, it is necessary to exercise a certain supervision over their operations. There is no magic in co-operation. The system is made as safe as possible by law and regulation, but inefficient management will, in the long run, have the same disastrous effect as in ordinary business life. It is, therefore, unfortunate that the common lack of special commercial experience among farmers is not always compensated for by the employment of trained and energetic managers. The full effect of this state of affairs is to a certain extent mitigated by the centralization of purchases and sales by means of central companies. But this is not enough.

Supervision is exercised by mean of occasional audit inspections by trained officials and by a system of returns. The sub-division's staff of inspectors is unfortunately small, and it has been necessary in the past to concentrate to a certain extent on the weaker associations. Inspectors are required to investigate conditions thoroughly. Copies of their reports are furnished to the directors and every effort is made by the Registrar to have errors of management or system disclosed put right. It cannot be doubted that the remarkable freedom of the movement from serious failures in recent years is largely due to this supervision.

The number of organizations registered during the twelve months ended 30th June, 1925, was 43, viz.:—

New Agricultural Co-operative Societies with unlimited liability	31
New Agricultural Co-operative Companies with limited liability	9
Existing Co-operative Agricultural Companies registered under section 57	1
New Consumers Trading Societies	2
	43

The following figures show the total number of co-operative associations registered at 30th June, 1925, and their membership:—

	Number.	Membership.
Co-operative Agricultural Societies with unlimited liability	152	14,793
Co-operative Agricultural Companies with limited liability	109	16,229
Consumers Co-operative Trading Societies with limited liability	11	8,782
Totals	272	39,804

2. *Removal of Societies from Register.*—The following fourteen associations were dissolved during the year:—

(i) *Unlimited Societies.*—Five dairy cattle and stud sheep societies which were established for five years and at the end of that time had repaid their loans from the Land Bank; two small special live stock societies which, after registration was effected, decided not to operate; one cheese factory; one general produce; and one wool society, all of which had been inactive for some years.

(ii) *Limited Liability Companies.*—One central fruit company dissolved to make place for a provincial central company in pursuance of the reorganization scheme of the Fruit Exchange; one formal fruit company, which is to be succeeded by a larger, more broadly based packing company; one consumers' trading society which wished to alter its articles of association in a manner infringing certain principles of the *Co-operative Act*; and finally the Farmers' Co-operative Meat Industries, Limited. This cold storage company applied and was registered as an already existing company in the special circumstances provided for in section 57 of the *Co-operative Act*. It later entered into a financial agreement with the Imperial Cold Storage Company, Limited, in terms of which the latter company obtained a measure of control in the management of the business. This agreement infringed the co-operative principle of democratic control by members, and it became the Registrar's duty to refuse registration of certain amendments of the articles of association involved. An appeal to court followed, as a result of

which the company's name was removed from the register. The business is being continued as an ordinary joint-stock company under the *Companies Act.*

3. *Maize and General Produce.*—The protracted drought and the locust pest which prevailed during the growing season 1923-1924, were manifest in the volume of business done by the maize co-operative societies, which is dependent upon the output of maize and the purchasing power of the individual members. Some 570,000 bags of grain only were received from members as compared with 1,658,001 bags in the previous season.

The maize was sold through the Central Agency for Co-operative Societies, Limited, in a general pool, which paid out the following satisfactory prices:—Grade 2, White Maize, 14s. 11d.; Grades 3 and 5, White Maize, 14s. 5d.; Grades 4 and 6, Yellow Maize, 14s. 3d.; White undergrades, 13s. 11d.; Yellow undergrades, 13s. 11d.

The membership of the maize societies in the Transvaal and Orange Free State was 7,888, equalling some 37·8 per cent. of the total number of farmers producing maize in the districts in which societies were operating. The turnover of the 22 societies during the past two seasons equalled respectively 15 per cent. and 9·6 per cent. of the total production of European farmers in the two Provinces. Thus a considerable portion of the smaller producers are members of the societies, while the larger producers are inclined to hold aloof. It can also be argued that the figures disclosed a growth of disloyalty among members; but in seasons of drought the producers in districts such as Vrede feed large quantities of grain to their stock and have little surplus for sale. Disloyalty is undoubtedly a serious evil. The two main causes are the credit system, which still obtains in some of the older societies, and the fact that a member of a co-operative society has to wait for final payment for his maize until the annual pool has been closed off. The credit system encourages disloyalty, since the knowledge that his debt will be deducted from the advance payable on his maize induces the producer to sell outside his society. The fact that the societies endeavour to make the final payment on one season's pool and the advance on the next within a period of a few weeks does not seem to meet the difficulty. However, an arrangement has now been come to with the Land Bank which permits of quarterly interim payments being made on the pool. It cannot be denied that the financial circumstances of many producers induce them to sell their annual crop as soon as it is reaped, almost regardless of price. Their maize is to a large extent produced on credit. The country traders are often the bankers and they require payment immediately the crop is ready for the market. In these circumstances it is apparent that the provision of personal credit facilities for producers, as contemplated by the draft Agricultural Credit Bill published during the last Session of Parliament, will strengthen the position of the co-operative societies.

The Central Agency for Co-operative Societies, Limited, purchased grain bags for the 1925 season to the value of £156,600 on behalf of its constituent members. This is a record. The price at which the bags were passed on to the members represented in the aggregate a very considerable saving to the industry.

A very important development of the year was the registration of the South African Maize Growers' Co-operative, Limited, on the 27th June, 1925. The formation of this limited liability company is an outcome of the efforts made to organize a general maize pool on a national basis, to which reference was made in the last Annual Report. Its purpose is to provide growers who are reluctant to become members of unlimited liability societies with an opportunity to organize and to market their maize in conjunction with the existing co-operative bodies through one channel.

Some of the general produce organizations in districts where maize is not produced had a remarkably successful year. The business of the Caledon Boeren Ko-operatieve Vereniging was nearly doubled during the year. The Weenen Farmers' Co-operative Society, Limited, which deals in lucerne, numbers all the growers in the district, bar two, among its members, a fact which speaks for itself. One company, the South African Produce Exchange, Limited, did not improve its position. This association suffered from the effects of bad management during an earlier period of its existence.

4. *Wool.*—The wool season opened with prices slightly in advance of those ruling at the close of the 1923-24 season, but from January onwards prices receded considerably. By June they were only slightly in advance of those ruling before the War.

The three co-operative companies dealing with wool each had a big increase in turnover during the year. Final returns were not available, but it was known that the Farmers' Co-operative Wool and Produce Union, Limited, of East London, handled during eleven months some 51,500 bales of wool and mohair which, together with skins and hides, realized £1,309,301. This was an increase of 21,400 bales and £656,301 in value over the previous financial year. The company has now established a branch at Port Elizabeth. The Boere Saamwerk, Beperk, handled 63,000 bales of a value of £1,461,224, representing an increase of 23,000 bales and £450,565 in value for the twelve months. The turnover of the Transvaalse Skaapboerevereniging was approximately £250,000, an increase of £70,000. These figures show that the companies earned the confidence of producers.

5. *Cotton.*—The 1923-24 cotton crop was disappointing. Rains in most parts were very late, holding back ploughing, so that the acreage planted was not what was anticipated. Unsatisfactory weather conditions adversely affected the yield per acre in many areas, and in the Rustenburg District the locusts played havoc with the cotton fields. Despite these circumstances the special efforts made to secure the organization of the growers while the industry is still in the development stage met with a great measure of success. The advantages of co-operation in keeping down ginning and selling costs and in marketing bulk consignments of even running qualities are readily appreciated, and nine co-operative associations are now handling cotton. A tenth has just been established in Griqualand West. Seven of the organizations deal exclusively with cotton. Three are general produce societies established at Lydenburg, Pietersburg, and Waterberg respectively, where the present

production of cotton does not justify the existence of specialist societies. With increased acreage, cotton-gins may be required in these districts and it is hoped that separate cotton societies will then be established.

The selling activities of the cotton societies and companies centre in the Co-operative Cotton Exchange, Limited, a central company owned and controlled by the local associations. The Exchange is supported by the Swaziland Cotton Growers, Limited, while the Northern Rhodesia Co-operative Ginneries, Limited, also recently affiliated. During the past year the Exchange was conceded the right to advise the Government on the expenditure of the cotton levy for the year 1925. It was estimated that the funds available would amount to at least £5,000, and the following allocation was agreed to:—Three scholarships at £200, £600; co-operative manurial experiments, £500; insectaries for the study of cotton pests, £500; administration expenses of the Exchange, £2,000; propaganda by the Exchange, £500: Total, £4,100.

The grant of £2,000 towards the expenses of the company made possible important developments in its business, and the Government's Senior Cotton Grader was employed as sales manager: this gentleman has an expert knowledge of the cotton market and his appointment should do much to ensure the efficiency of the services rendered by the company. The Board also decided that no commission should be charged on sales of members' cotton during the current year.

6. *Fruit.*—The co-operative fruit growers organizations consist of local or district co-operative associations, of provincial central companies and finally of the federal company, the Fruit Growers' Co-operative Exchange of South Africa, Limited. The Exchange was formed in December, 1922. In its first two years the divergent interests of growers of different types of fruit and in different parts of South Africa occasioned dissatisfaction with certain details in the company's internal administration. In an earnest endeavour to remove all cause of criticism a scheme of reorganization was decided upon, the main feature of which is that the management of the business and of the revenues of the company, in so far as they relate to the interests of citrus, deciduous, and pineapple growers respectively, is vested entirely in sub-boards representing those divisions. For this purpose a new set of articles of association, prepared in the sub-division, was adopted by the Exchange, after consultation with a committee consisting partly of the representatives of district co-operative associations which have hitherto held aloof. The Exchange at present represents some 886 growers.

The action taken by the Government on the report of the commission appointed at the request and the expense of the Exchange to inquire into the fruit export trade and the control of shipping space, tended to strengthen the position of the company and the confidence of its members.

The sub-division paid a good deal of attention during the year to the district fruit organizations. A number of the older organizations are doing a comparatively extensive business, but others have hitherto confined their attention to centralizing the purchase of packing material and providing their members with the benefits of

affiliation with the Fruit Exchange. A few of the hard fruit associations are operating central packing sheds. A very promising company was being organized at Rustenburg for this purpose. Two co-operative associations have undertaken the fumigation of orchards and have given great satisfaction to their members both as regards efficiency of service and reduction in expense.

7. *Dried Fruit, Raisins.*—The membership of the companies dealing in these products continued to show an annual increase. There can be no doubt that the benefits of co-operation are being realized more and more. In this connexion it is interesting to note that the Australian States recently adopted legislation compelling a measure of co-operation in the marketing of dried fruits, more particularly in the regulation of supplies for the home and export markets. The Worcester Boeren Rozijnen Ko-operatieve Vereniging, Beperkt, handled 2,402,640 lb. of raisins and sultanas during the year, an increase of approximately 30,000 lb. Practically the whole output was sold overseas. The sales of the South African Dried Fruits Company during its last financial year totalled £97,341. Sales in South Africa amounted to £51,527, an increase of £9,000. The financial statements showed a surplus on the year's working of £27,796, of which £26,196 was distributed. The final prices received by members on the majority of fruits were higher than in the previous season. The development of the company is reflected in the fact that the turnover twelve years ago was approximately £15,000. The company has done its utmost to secure an improvement in quality of the members' produce by sending its experts about the raisin and sultana growing areas to teach better methods on the farms. These efforts were, however, handicapped by the action of the Ko-operatieve Wijnbouwers, Beperkt, in subsidizing the making of raisins and dried grapes at a flat rate per lb. regardless of quality. The object of the last mentioned company was to reduce the production of surplus wine, and it consequently regarded the product from a spirit-content basis only. An outcome of the representations made by the dried fruit companies on this point is the possibility of a central co-operative control being established, which will ultimately tend to stabilize the market for raisins and sultanas. The difficulty of disposing satisfactorily of poor grade products led the South African Dried Fruit Company to pay considerable attention to encouraging increased consumption of dried fruits by the native population, and particularly on the mines. There is, however, a distinct prejudice to be overcome, but once a market is created it will always remain. A very interesting dried fruit manufacturing company was formed during the year at Longhope, in the eastern Cape Province. The South African Dehydrated Fruits Co-operative Company, Limited, is the first co-operative association to undertake the mechanical dehydration of fruits. This is a new scientific method which has gained favour in California in recent years. The factory will be the second of its kind in the Union, and its members are growing apricots on a very large scale.

8. *Wine.*—The *Wine and Spirits Control Act* came into operation on the 21st March, 1924.

The production of wine during the 1924 season, including raisins, dried grapes, and good wine, was returned as 115,558 leaguers. Of this vintage there were—

	Leaguers.
Returned as good wine, which, in accordance with the *Wine and Spirits Control Act* did not fall under the control of the Ko-operatieve Wijnbouwers' Vereniging van Zuid-Afrika, Beperkt	27,035
Returned by farmers as wine for their own use	4,855
Dealt with by the Ko-operatieve Wijnbouwers' Vereniging van Zuid-Afrika, Beperkt, under the aforementioned Act, including raisins and dried grapes	70,872
Unaccounted for and probably disposed of prior to the commencement of the *Wine and Spirits Control Act*	12,796
	115,558

The price of the distilling wine was fixed by the Ko-operatieve Wijnbouwers' Vereniging van Zuid-Afrika, Beperkt, at £7. 18s. 9d. A 50 per cent. surplus was declared, and the farmer was paid £3. 19s. 4½d. a leaguer at 20 per cent. strength. At the end of the year a further 5s. 3½d. a leaguer was paid, making a total of £4. 4s. 8d. In 1923 the price paid to members was £3, and non-members who sold 1924 wine before the promulgation of the *Wine and Spirits Control Act* are said to have realized from £3. 5s. to £3. 10s. a leaguer. In the 1923 season some 40,000 leaguers of surplus wine were destroyed. In 1924 no wine was destroyed. This was the effect of the company's having done everything possible to deal with the problem of over-production. Approximately 5,200 leaguers were taken in trust, and to encourage the farmer to produce less alcohol the making of raisins, dried grapes, and grape syrup was subsidized, with the result that the equivalent of 20,000 leaguers were used in this way. The company also employs an expert who devotes his whole time to assisting farmers in the making of superior wines. During the year the company erected pot-stills at four centres and stores at Stellenbosch, Paarl, and Worcester. This will mean that fairly large quantities of matured brandy will be available in 1928. The company also set aside £10,000 for the maturing of wines for export. Contrary to expectation the membership of the company increased by 129 during the year in which the *Wine and Spirits Control Act* came into operation.

9. *Tobacco.*—A short tobacco crop in the Rustenburg District resulted in a considerable diminution of the turnover of the Magaliesberg Ko-operatieve Tabakplanters' Vereniging. Members delivered approximately 2,761,935 lb. of leaf tobacco, as compared with 3,307,807 lb. in 1923. Prices paid to members were the same in the two years. This society has accumulated a Reserve Fund of £45,220 and its financial position is all that can be desired. The membership at 30th June, 1925, was 3,338, and three months later had increased by another 100. The Vaal Rivier Ko-operatieve

Tabak Boeren Vereniging also felt the effects of a poor crop. Members delivered only 41,479 lb. The pool worked out satisfactorily, and the society made a good profit on the year's working. The Western Province Tobacco Growers' Company, Limited, handled 765,450 lb., for which an average price of 1s. 11¾d. per lb. was paid to the producers, as compared with 511,500 lb. paid for at an average of 2s. 2½d. a lb. in 1923. The company handles Turkish leaf and claims to control at least 80 per cent. of the output of its area. Its membership is 286, representing an increase of 40 during the year. The Pietersburg Ko-operatieve Landbouwvereniging was originally formed to deal with tobacco and wheat only, but was subsequently converted into a general produce society. As such it has made remarkable progress. Its membership rose from 50 in January, 1923, to 273 in June, 1925. As indicating the success of its operations it might be mentioned that before its formation growers seldom received more than 5d. per lb. for the best quality tobacco, and then they were usually required to accept payment half in goods and half in cash. Buyers are now paying 8d. and 9d. per lb. for good qualities.

10. *Meat.*—The possibility of organizing the cattle industry on a sound co-operative basis has been under consideration for some years, but while the matter has been discussed in detail by various conferences and committees, no definite action has as yet been decided upon. In view of the failure of the late Meat Producers' Exchange and the lack of success of another large meat organization in which farmers are interested, it is felt that the greatest care must be exercised in forming new cattle farmers companies. Within the last few months, however, the Board of Trade has issued a report on the problems involved, and the proposals put forward are being carefully considered throughout the country.

11. *Creamery and Cheese Associations.*—The number of these associations registered on the 30th June, 1925, was 20. The financial years of some of the organizations end on the 30th September and details as to the business done during the season 1924-25 were not available. The returns from the Natal companies for the financial year 1923-24 showed a very considerable decrease in output, due to a dry season and the locust invasion of 1924. The scarcity of supplies, however, influenced the prices paid for butter-fat, which were consistently in the neighbourhood of 1s. 6d. per lb. In the case of Joseph Baynes, Limited, the drop in turnover was in some part due to the company's having withdrawn from various areas where cream had previously been purchased in opposition to other companies working on co-operative lines. Conditions in most parts of the Union were not so favourable to production of cheese and butter during 1924-25 as in the previous year. In view of the early rains a record season was anticipated, but continuous and excessive downpours resulted in a small milk supply. The societies in the northern districts of the Cape Province, with but one exception, all had a decrease in turnover. Prices paid to members averaged approximately 6d. per gallon for milk and 1s. 6d. per lb. for butter-fat, in East Griqualand, individual associations increased their output as a result of increased membership, but on the whole

production was estimated to have been 25 per cent. less than in the previous season. Prices paid to members were also lower. In the western Cape Province the Darling Co-operative Creamery manufactured 427,000 lb. of butter, an increase of 24,000 lb. Sale prices averaged 1s. 9d. per lb. as against 2s. 1d. in the previous year. The membership showed an increase of 29. In Zululand, drought and, later, abnormal rainfall affected the milk supply. The output of the two factories operated by the Farmers' Co-operative Industries, Limited, was notably less than in the previous season. A satisfactory feature was an increase of 44 in the number of suppliers.

Cheese factories throughout the Union were faced by a very serious problem in the early months of the year 1924-25, when, in anticipation of a record production, prices fell to an unpayable level. In good seasons the South African production of cheese exceeds the consumption, but no individual company cares to undertake export because of the low prices returned. In these circumstances several conferences were held to consider the formation of an association which would have power to require its members to contribute a certain quota of its total production for export. The diminished output due to the excessive rains led to the scheme being shelved for the time being, but co-operation between the factories in this matter is likely to become urgently necessary in the near future. The discussions at the conferences referred to resulted in a reasonable selling price being maintained by the various factories. This is very much to the good; a consistent market price for cheese will induce consistency of milk supply and encourage farmers to improve their dairy herds.

12. *Fresh Milk Selling Societies.*—There are four co-operative associations undertaking the retail distribution of fresh milk. The sales of the East London Model Dairy Society during its last financial year totalled £26,795, an increase of approximately £4,500 on the previous year. Members received from 9d. to 11d. per gallon during the summer and from 11d. to 1s. 4d. during winter. The turnover of the Albany Dairy Farmers' Co-operative Society, £4,670, was approximately the same as in the previous year, while prices paid to members were on an average slightly higher. The Farmers' Co-operative Dairies, Limited, at Camperdown, commenced business in June last. Its milk is sold in Durban. The Natal Creameries, Limited, in addition to its cheese and butter operations, sells some 500,000 gallons of fresh milk annually. It has paid suppliers a minimum of 1s. per gallon for "quota" milk for the past three years.

13. *Eggs and Poultry.*—It is pleasing to be able to record a great improvement in the business of the co-operative egg and poultry associations, of which there are nine operating. In the majority of these associations a most striking increase in the support enjoyed showed in the clearest possible way that the confidence of producers had been obtained. The Natal Co-operative Egg Circle, Limited, nearly doubled its turnover, and its membership increased by 56. The prices distributed were slightly less than in the previous year. The East London and Border Co-operative Poultry Products, Limited, increased its membership from 45 to 71 and its

turnover proportionately. The prices paid for eggs were considerably higher. The Cape Egg Circle handled 2,395,115 eggs as against 1,765,605 in the previous year. No fewer than 93 new members were obtained. The annual financial statements of the Vrystaatse Ko-operatiewe Eier Kring, Beperk, are not to hand, but it is known that 63 new members have joined and that the volume of business was greatly increased. The Addo Poultry Exchange Co-operative, Limited, handled 1,141,380 eggs and poultry foods to the value of £4,850. One company, the Port Elizabeth and District Co-operative Poultry Products, Limited, was most unfortunate. The business of this association was exhaustively investigated by one of the inspectors of the sub-division in June, 1924, when it was found that mismanagement had occurred and that the company was in a disorganized condition. Serious representations were at once made to the board of directors, and the business was reorganized. In the new year affairs were recovering well and the turnover was steadily increasing, when the confidence of members was again rudely shaken. It was found that the company's depot manager had misappropriated funds. In view of these occurrences it is not suprising that the profit and loss account for the year showed a loss of £235. The business is, however, being continued, and it is hoped that the confidence of producers will be regained in the new year. That this can be done is proved by the history of the Transvaal Egg Circle. This company was formed on 31st October, 1922. In its first year, gross mismanagement by officials brought it to the point of liquidation, and a number of members withdrew their support. After a close inspection, however, the business was thoroughly reorganized under the supervision of the sub-division. Monthly inspections were then made by officials till the wholehearted efforts of the board of directors had regained the confidence of producers. An increase of 80 members during the four months of the current financial year showed that this had been done. In the same period the company handled an average of 201,384 eggs a month, while its sales of poultry foods and requirements increased fourfold. The business is progressing by leaps and bounds and has every prospect of a successful future.

14. *Sugar.*—The Umfolosi Co-operative Sugar Planters, Limited, completed its milling season in the year under review, having handled 101,172 tons of cane from which 7,108 tons of sugar were made. The average of the prices received by members was 15s. 9.1d. The principle of payment for cane on the basis of its sucrose-content has been adopted, so that members receive the actual commercial value of their products.

The company was formed in 1923 when the planters, who are Government settlers, were faced with ruin as a result of the closing of the local mill, which provided them with a market for their cane. The mill was purchased for £30,000 and reconditioned at a cost of £94,174, a loan being obtained for the purpose from the Land Bank on the guarantee of the members, supported by a contingent liability undertaken by the Department of Lands. Redemption charges are deducted from the amounts due to members on their cane, fully paid up shares being issued in respect of the deductions. Subsequent to the period covered by this report the company's

property was very seriously damaged by floods and it has become necessary to remove the mill to another site. It has been ascertained that crushing operations will not be possible this season, and contracts have therefore been entered into with two Natal milling companies. These developments will be discussed more fully in the next report.

The only other sugar planters' co-operative company registered is the Eshowe Co-operative Company, Limited. This small company was formed in 1923 to enable growers to sell their cane collectively to the mills and to provide transport facilities. By reason of collective selling members were enabled to obtain financial assistance in breaking new fields. Cane growing is a comparatively new industry in the Eshowe District and the aim of the company is to obtain a sufficient production to justify the erection of a co-operative mill in the future.

15. *Ground-nuts.*—The production of ground-nuts is an important industry in certain districts of the northern Transvaal. Growers have, however, to contend with strong competition in the South African market from the Mozambique Province, and are furthermore handicapped by the greatly fluctuating market prices resulting from the haphazard way in which the crop is marketed. In these circumstances the sub-division recently made an earnest effort to establish a strong marketing association in the Potgietersrust area, which could enter the export trade on a satisfactory footing; but after a number of public meetings had been attended and a considerable amount of work done, the project had to be abandoned for the time being in consequence of the general apathy of the growers.

The small co-operative ground-nuts company formed two years ago at Naboomspruit enjoyed a measure of success during the past year, in that it paid out satisfactory prices and increased its membership by some 85 per cent. Unfortunately, the company has been greatly handicapped by its lack of adequate plant and storage accommodation, due to its failure to obtain a loan from the Land Bank on terms satisfactory to its members. It has not hitherto been able to embark on an export trade.

16. *Timber.*—The operations of the five co-operative timber companies of Umvoti County and of their central agency during the year were notably successful. The prices at which mining timber was sold in years past, owing to the middlemen undercutting each other, left little profit to the grower. The co-operative companies are supported by the majority of the growers of the district and have been leading factors in bringing about a general 25 per cent. increase in prices. This, and the results attained by the Union Co-operative Wattle Milling Company mentioned later, put new life into an important industry which to all appearance was on the downward grade. Reports state that for the first time in years the acreage planted with wattle trees showed a considerable increase. The companies succeeded in obtaining certain adjustments in railway tariffs of considerable importance to growers. However, the latter are still forced by prohibitive railway rates to destroy annually many thousands of tons of excellent firewood. The co-operative companies could build up a large trade in firewood if coal freightage

rates could be obtained. It is understood that these have been refused by the South African Railways Administration for important reasons.

17. *Wattle Bark Milling Company.*—An important co-operative wattle bark milling company was established in January last at Dalton, in Natal. Conditions in the market for wattle bark had long been unsatisfactory. Violent fluctuations in prices and even more serious evils were making wattle growing an unprofitable business. A great number of shall proprietary mills had grown up, which had no facilities for the storage of bark nor the necessary financial resources to enable them to hold for a favourable market, with the result that they were forced to dump the bark on the market as soon as it was chopped. Competitive selling annually forced the price much below the overseas level. In these circumstances a powerful body of growers organized, with the assistance of this office, to purchase the largest and most efficient of the mills for the sum of £45,000. The terms of purchase were most favourable, the proprietary company making no secret of the fact that they had failed to secure a sufficient turnover to make the business pay. After close inquiry, the Department was satisfied that this and other factors for success were secured to the proposed co-operative company and registration was effected. The company has been outstandingly successful. It automatically had a most beneficial result on certain features in the market under which growers had suffered, with the result that the prices obtained were much better than for years past. Members claim that they received £80,000 more to date than for similar quantities in the previous season. Producers who owned mills have closed them down because it paid them to support the co-operative company. The membership increased from 55 to 88.

18. *Apiaries.*—One of the most interesting of the smaller co-operative companies is one dealing entirely with honey. This is the Sundays River Co-operative Apiaries, Limited, a little local association established a year ago with a capital of £144. Unfortunately, conditions were not entirely favourable to its progress, the area having suffered from drought, with the result that production fell off and some of the beekeepers lost interest. The company's product has, however, become well known throughout the Union, and, in view of what the district is capable of producing in normal seasons, it is hoped that the set back will prove to be purely temporary. Beekeeping is said to be one of the most profitable of the minor industries connected with agriculture, and demands little expenditure either in time or capital. Many of the most successful beekeepers are, indeed, very busy men with other exacting occupations. The conditions for honey production are very favourable in many districts of the Union, and it is somewhat surprising that farmers do not pay more attention to this sideline. One of the main causes is undoubtedly the absence of a system of marketing which will provide for suitable grading and for the regular supply of sufficient quantities to the distributors. The individual producer can only dispose of his product successfully in very favourable circumstances. By applying the principal of co-operation the most distant producer can be brought into immediate touch with the best market, and grading and other essentials to successful marketing

can be attended to. For these reasons the formation of a co-operative company in a central place, which could draw support from widely scattered areas, would be a great boon to producers and a great encouragement to the industry.

19. *Special Live Stock Societies.*—Needy farmers in the districts in which the Government scheme for the establishment of small live stock societies operates are continuing to avail themselves of the facilities afforded to rehabilitate themselves. A considerable number of societies of this description have been registered, while applications for the registration of new societies are constantly being received. Representations were recently made for an extension of the scheme to further districts, but the Department's view is that the time is not yet ripe for such a step. The scheme is still in an experimental stage and it remains to be seen whether the stock supplied, with its natural increase, is able in itself to produce the instalments under the loans granted by the Land Bank. When the societies at present in operation have proved themselves, the question of an extension of the movement will be considered.

20. *Dairy Cattle and Stud Stock Societies.*—The object of these associations is to supply their members with stock of a good quality on easy terms. They are financed by the Land Bank.

21. *Insurance.*—In view of the benefits of co-operative insurance, provision was made in the *Co-operative Act* of 1922 for the formation of farmers' associations to carry on co-operative produce, live stock, and warehouse insurance. But with the passing of the *Insurance Act* in the following year it became impossible to form such associations owing to a deposit of £10,000 and an annual licence fee of £50 being required. Farmers' co-operative insurance schemes affect the members only and not the general public, and for this reason it was thought possible to exempt them from the requirements of the *Insurance Act*. A provision to this effect was accordingly inserted in the Draft Bill to amend the *Co-operative Societies Act*, which was submitted to the last Session of Parliament. The clause was deleted, however, during the passage of the Bill.

22. *Federal Companies.*—The two federal companies appearing on the register are the Federated Farmers' Co-operative Association of South Africa, Limited, and the Fruit-growers' Co-operative Exchange. The latter has been referred to under the section of this report dealing with fruit associations.

The former is the South African member of the Overseas Farmers' Co-operative Federations, Limited, a London company representing associations of primary producers in Australia, New Zealand, and South Africa. The chief function of the South African company is to sell the produce of its members in the European market and to purchase their combined requirements. It has a membership of 24 associations, whose turnover with the overseas company during the financial year 1925 was £99,449. The position of the South African organization will probably be greatly strengthened in the near future. Support from the co-operative egg circles was

recently obtained and the Central Agency for Co-operative Societies, Limited, is now negotiating for the sale of its export maize through the overseas company.

23. *Trading Societies.*—The co-operative movement is developing very slowly among consumers in South Africa. Only two new societies were registered during the year. The total membership is 8,782. The two new companies registered were the Pretoria Public Service Co-operative Depôt, Limited, and the Randfontein Mines Co-operative Stores, Limited. Both companies were well supported.

The Pretoria association did not commence business until the 1st June. The total turnover of the other associations during the year was £495,805.

REPORT No. X.—PUBLICATIONS.

A.—Editor, "Journal of the Department of Agriculture":
G. W. KLERCK.

1. *General.*—That publicity is valuable and necessary is increasingly acknowledged, and evidence of this is seen in the many journals, etc., that have come into being for the purpose of making known the work and aspirations of various organizations and businesses. The need particularly for the Department to publish the results of its investigations, and so generally to keep in close touch with the farming community, is clear. Large sums of public money are spent by the Department, and the full and practical value therefrom cannot be expected unless the farmer is put in possession of the resultant agricultural knowledge. While much is being done in bringing the Department to the farmer, the chief means of doing so still remains the printed word, whether it be in the form of a monthly journal, a pamphlet, or any other printed matter. Recognizing, therefore, the great dependency of the Department on its system of publications, much thought has been given to the matter during the past year, and good results therefrom are on the point of fruition. A Publicity Committee has been formed, composed of a number of senior officials of the Department, which will considerably strengthen the Department's publication section and assist the Secretary by advice on various matters concerning publicity work generally.

A system of weekly "news letters," consisting of a printed advice sheet, will shortly be in operation. The sheet, which will have a wide distribution, will give in clear, simple language essential information on matters that should be known to every farmer. The large number of departmental officers who, in the course of their ordinary duties, come in touch with farmers will use these leaflets for the purpose of giving word-of-mouth information. The leaflet will go to all teachers in rural schools and be used for instructional purposes to their pupils, and will, possibly, through the pupil reach the parent as well. It will be displayed at post offices and magistrates' offices throughout the Union, and it is expected that the Press generally will publish the series, so that altogether the information contained in these leaflets should reach many farmers.

The issue of a farmer's handbook is also contemplated, which will furnish information on a comprehensive selection of subjects. Such a book would be invaluable for purposes of reference in regard to many of our agricultural practices and problems.

It has also been decided to develop the Department's *Journal* by issuing a monthly publication drawn up on broader and simpler lines than the present one. It is recognized that the farmer wants brief, plainly worded advice put up in a manner that arrests the

attention, and it is hoped that the new *Journal* will meet this need. The present *Journal* has served a useful purpose: it has set a high standard for South African agricultural literature, and has helped to establish the status of the Department as one of the foremost in State organizations. During its existence it has published a wealth of carefully prepared and selected literature that is not only of great value to the present generation of farmers, but will stand as a work of reference for all time. Nor will this *Journal* be discontinued. It is read by a widespread circle of farmers who have learnt that the success of their enterprise depends upon the application of up-to-date methods. Moreover, the class of article it now publishes is the basis of South African agricultural knowledge, and will continue to be needed and to be written. This *Journal*, with certain modifications, will therefore be published quarterly, and so continue as a source of education and reference and as a history of our agricultural development.

But whether in a "popular" monthly form or in the more scientific quarterly, it is desired to make it clear that these publications are of an official nature and as such are necessarily confined within definite limits. They are the mouthpiece of the Department, a function increasingly important in an age that recognizes the value of publicity and education. In the latter respect may be mentioned the call for agricultural bias in the curriculum of our primary and secondary schools, and the demand it will create for sound, authoritative literature.

2. *Circulation.*—About 10,400 copies of the *Journal* are published every month, 7,500 of which are in English and 2,900 in Afrikaans. The *Journal* is used as a medium of exchange with other countries, and in this country is sent to a large number of officials as well as to all farmers' associations, public libraries, members of the Union and Provincial legislatures, etc., requiring altogether a "free list" of 7,490 copies monthly (5,160 English and 2,330 Afrikaans). Included in this list are 4,050 crop correspondents, so that with the 2,500 subscribers (2,000 English and 500 Afrikaans) it is seen that at a minimum the *Journal* reaches 6,500 farmers. This is small in comparison with the number of farmers in the Union; nevertheless it is encouraging to know that the *Journal* is in the hands of the leaders of agricultural development, and many acknowledge the invaluable nature of the literature it publishes.

3. *Revenue and Expenditure.*—The total revenue for the year—subscriptions and advertisements—was £1,740, while the cost of publishing was £5,680 (£3,692 English and £1,988 Afrikaans), or equivalent to 9.2d. per copy for the English version, and 12.6d. for the Afrikaans. The subscription is 5s. per annum. In addition, the cost of printing departmental bulletins was £1,630.

4. *Miscellaneous Publications.*—In addition to the monthly *Journal*, the Department issues literature in the form of bulletins (reprints, pamphlets, etc.). Some of these are of a highly scientific character, such as certain publications of the Divisions of Veterinary Education and Research, Botany, Entomology, and Chemistry, but the majority are in a form suitable for the farmer, and these comprise at present a list of 170. During the year 56 reprints, 2 bulletins, and 6 science bulletins (in addition to other publications) were issued

by the Department and most of them placed on the bulletin list. This list is constantly being revised, old bulletins being removed and new ones added at frequent intervals. Some of the bulletins are priced. It is an important section of departmental work; these bulletins are widely distributed by the schools and divisions of the Department to which supplies of bulletins are sent. In addition, this office also dealt with 3,049 requests from farmers and others for specific bulletins, and so distributed during the year 38,940 bulletins, bringing in a revenue of £129, which is a marked advance on the previous year.

B.—Librarian: D. S. VAN WARMELO.

A departmental committee was appointed during the period under review to investigate the desirability of issuing a more comprehensive catalogue than the book-list originally prepared for general distribution. As stated in last year's report, the books had been classified according to authors' names and grouped into main classes and divisions. This book-list is now with the Government Printer. The committee, however, recommended instead the publication of a complete catalogue in the form of an author-subject index, but at the same time agreed to the issue of the book-list exclusively for departmental use. A complete catalogue, as recommended, will no doubt serve a far more useful purpose, but its compilation will take many months, and the list of books will in the meantime be a good substitute, and will at any rate remain an asset, especially to the library.

As a result of the reorganization that has taken place in the Department, there has followed a steady increase in the activities of the library, and it is pleasant to note that its literature has been in much greater demand than in previous years.

THE DEPARTMENT OF AGRICULTURE.

Abridged List of Staff.

ADMINISTRATION
(Union Buildings, Pretoria).

Secretary for Agriculture	P. J. du Toit.
Under-Secretary for Agriculture	Lt.-Col. G. N. Williams, D.S.O.
Chief Clerk	F. W. Green.
Accountant	W. H. L. Friedrichs.

Publications.

Editor	G. W. Klerck.
Librarian	D. S. van Warmelo.

DIVISIONS.

Veterinary.

Principal Veterinary Officer	J. D. Borthwick. M.R.C.V.S.
Assistant Principal Veterinary Officer ...	A. Goodall, F.R.C.V.S.
Senior Veterinary Officer, Natal	W. M. Power. M.R.C.V.S., Pietermaritzburg.
Senior Veterinary Officer, Transvaal ...	G. May (Acting), M.R.C.V.S., Pretoria.
Senior Veterinary Officer, O.F.S.	A. Grist, M.R.C.V.S., Bloemfontein.
Senior Veterinary Officer, Cape West ...	J. Spreull, F.R.C.V.S., Capetown.
Senior Veterinary Officer, Cape East ...	Vacant.
Senior Veterinary Officer, Transkei	G. W. Freer, M.R.C.V.S., Umtata.
Senior Veterinary Officer, S.W.A. Protectorate	R. S. Garraway, Windhoek.

Veterinary Education and Research.

Director of Veterinary Education and Research and Dean of the Faculty of Veterinary Science	Sir Arnold Theiler, K.C.M.G., D.Sc., etc.
Deputy-Director of Veterinary Education and Research and Professor of Hygiene and Infectious Diseases	P. J. du Toit, B.A., Ph.D., Dr.Med.Vet.
Sub-Director of Veterinary Education and Research and Professor in Biochemistry	H. H. Green. D.Sc.
Sub-Director of Veterinary Education and Research and Professor in Applied Research	P. R. Viljoen, M.R.C.V.S., Dr.Med Vet.(Berne).
Senior Research Officer and Professor in Physiology	Vacant.
Senior Research Officer and Professor in Veterinary Anatomy	G. v. d. W. de Kock, M.R.C.V.S., Dr.Med.Vet. (Hanover).
Senior Research Officer and Lecturer in Surgery	J. B. Quinlan, B.A., M.R.C.V.S., Dr.Med.Vet.
Senior Research Officer and Lecturer in Veterinary Medicine	C. P. Neser, B.A., D.Sc., M.R.C.V.S.
Research Officer and Lecturer in Ecology	A. O. D. Mogg, M.A.
Research Officers	G. A. H. Bedford, F.E.S.; J. P. van Zyl, B.A., Ph.D.; P. J. J. Fourie, M.R.C.V.S.; H. O. Monnig, B.A.,Ph.D.; G. Martinaglia, B.V.Sc.; M. W. Sheppard, B.A., M.R.C.V.S.; H. H. Curson, M.R.C.V.S.; Dr. F. Veglia; E. M. Robinson, M.R.C.V.S., Dr. Med.Vet.; M. Henrici, Ph.D.; P. le Roux, M.R.C.V.S., B.V.Sc.; Prof. Mettam; W. J. B. Green, B.V.Sc.; J. I. Quin, B.V.Sc.; J. H. R. Bisschop, B.Sc., B.V.Sc.

Armoedsvlakte Laboratory.

Officer in Charge and Lecturer in Helminthology	J. R. Scheuber, Dr.Med.Vet.

Allerton Laboratory, near Pietermaritzburg.

Sub-Director for Routine and Research and Officer in Charge	D. T. Mitchell, M.R.C.V.S.

Animal and Field Husbandry.

Director of Animal and Field Husbandry ...	R. W. Thornton.
Principal Sheep and Wool Expert	A. G. Michaelian, Pretoria.
Senior Sheep and Wool Expert	W. S. van Heerden, Glen.
Senior Sheep and Wool Expert	D. J. R. Mellet, Grootfontein School of Agriculture.
Sheep and Wool Expert	F. C. P. Stow, Kroonstad.
Sheep and Wool Expert	J. H. Kruger, Edenburg.
Sheep and Wool Expert	B. M. Hartigan, De Aar.
Sheep and Wool Expert	A. J. G. van Zyl, Kimberley.
Sheep and Wool Expert	C. J. de Zwaan, Cedara.
Sheep and Wool Expert	G. S. Mare, Middelburg, Cape.
Sheep and Wool Expert	L. Badenhorst, Ermelo.
Sheep and Wool Expert	P. J. v. d. Merwe, Dordrecht.
Sheep and Wool Expert	C. R. Wyche, Queenstown.
Sheep and Wool Expert	N. G. Wessels, Middelburg, Cape.

Dairying.

Superintendent of Dairying	E. O. Challis.
Assistant Superintendent of Dairying ...	E. G. Hardy.
Dairy Inspector, Transvaal	D. J. Retief, M.Sc.(Agr.), Pretoria.
Dairy Inspector, Transvaal	E. W. Sampson, B.A., Pretoria.
Dairy Inspector, Orange Free State... ...	L. J. Veenstra, Bloemfontein.
Dairy Inspector, Transvaal	B. W. Sutton, Pretoria.
Dairy Inspector, Cape...	J. Allison, Capetown.
Dairy Inspector, Cape...	F. Wilkinson, Queenstown.
Dairy Inspector, Natal	J. P. Gow, Pietermaritzburg.
Government Cheese Grader, Cape	S. Groot, Aliwal North.
Government Cheese Grader, East Griqualand	J. F. Stephenson, Kokstad.

Egg Inspection.

Chief Poultry Officer	R. Bourlay, Potchefstroom.
Poultry Officer...	E. van Manen, Potchefstroom.
Inspector and Itinerant Instructor	H. Leitch Anderson, Johannesburg.
Inspector and Itinerant Instructor	E. F. Lombard, Grootfontein.
Inspector and Itinerant Instructor	C. A. Pereira, Cedara.
Inspector and Itinerant Instructor	F. J. McArthur, Elsenburg.

Tobacco and Cotton.

Chief	W. H. Scherffius, M.Sc.
Acting Assistant Chief and Manager, Experiment Station, Rustenburg	P. Koch, B.Sc.(Agr.).
Manager, Turkish Tobacco Experiment Station, Elsenburg	P. J. Naude, M.Sc., M.A.
Cotton Geneticist	A. R. Pullen, Rustenburg.
Senior Tobacco and Cotton Expert	L. Worrall, M.Sc., Barberton.
Senior Cotton Grader	C. J. Homewood, Durban.
Itinerant Instructor and Cotton Grader ...	V. F. Olivier, B.Sc., Oudtshoorn.
Itinerant Instructor and Cotton Grader ...	L. J. Henning, M.Sc., Rustenburg.
Itinerant Instructor and Cotton Grader ...	F. M. du Toit, Louis Trichardt.
Itinerant Instructor	N. L. Mansvelt, Parys.
Itinerant Instructor	E. H. Powell, Eshowe.
Itinerant Instructor	H. J. Smuts, Elsenburg.

Horticulture.

Chief Horticulturist	I. Tribolet, Pretoria.
Fruit Inspector, Capetown	H. D. Roworth, Capetown.
Itinerant Instructor	J. le Roux, Capetown.
Itinerant Instructor	F. J. de Villiers, B.A., M.Sc., Ph.D., Elsenburg.
Horticulturist (Citrus Specialist)	B. J. Blatt, B.Sc., Ph.D., Pretoria
Dried Fruit Officer	F. L. Perkins, Elsenburg.
Chief Fruit Inspector	R. J. Bulmer, Capetown.

Viticulture.

Government Viticulturist	S. W. van Niekerk, Elsenburg.
Assistant Viticulturist...	G. F. Fevrier, B.A., Elsenburg.
Manager, Government Wine Farm, Constantia, Wynberg	A. G. van Renen.
Officer in Charge, Paarl Viticultural Station	J. C. van Jaarsveld
Scientific Assistant	C. J. Theron, B.Sc.(Agr.), Elsenburg.

Guano Islands.

Superintendent	W. R. Zeederberg, Capetown.

Brands.

Registrar	J. C. Goldman, Pretoria.

Botany and Plant Pathology.

Chief of Division	I. B. Pole Evans, C.M.G., M.A., D.Sc., F.L.S.
Assistant Chief and Senior Research Officer	E. M. Doidge, M.A., D.Sc., F.L.S.
Senior Botanist, Pretoria	E. P. Phillips, M.A., D.Sc., F.L.S., F.R.S.(S.A.).
Mycologist, Capetown...	R. Davies, B.Sc.
Mycologist in Charge, Cryptogamic Station, Pretoria	A. M. Bottomley, B.A.
Mycologist, Capetown...	V. A. Putterill, M.A.
Mycologist, Durban	H. H. Storey, B A.
Mycologist, Pretoria	C. J. Hopkins, B.Sc.
Mycologist (Plant Pathologist), Pretoria ...	E. S. Moore, B.Sc., Ph.D.
Physicist, Capetown	E. A. Griffiths.
Botanist, Pretoria	C. A. Smith, B.Sc.
Botanist, Pretoria	A. P. D. McClean, M.Sc.
Agrostologist, Pretoria	S. M. Stent.
Botanist (Botanical Survey), Grahamstown	R. A. Dyer, M.Sc.
Botanist (Botanical Survey), Pretoria ...	C. D. B. Liebenberg, B.Sc.

Entomology.

Chief of Division	C. P. Lounsbury, B.Sc.
Assistant Chief...	Claude Fuller.
Senior Entomologist, ...	C. W. Mally, D.Sc., Pretoria.
Entomologist, Natal	C. P. v. d. Merwe, Durban.
Entomologist, Eastern Province	D. Gunn, Port Elizabeth.
Entomologist	H. K. Munro, B.Sc., F.E.S.(Lond.). Pretoria.
Entomologist, Transvaal	G. C. Haines, M.Sc., Pretoria.
Entomologist	R. W. E. Tucker, M.A., Capetown.
Entomologist	A. E. Lundie, M.A., B.Sc., Ph.D., Pretoria.
Entomologist	T. J. Naude, M.Sc., Ph.D., Pretoria.
Entomologist	F. G. C. Tooke, M.Sc., Rosebank.
Entomologist	C. J. Joubert, B.Sc., Elsenburg.
Entomologist	J. T. Potgieter, M.Sc., Ph.D., Pretoria.
Entomologist	F. Taylor, Potchefstroom.
Entomologist	A. J. Smith, B Sc., Rustenburg.
Entomologist	G. A. Hepburn, Cedara.

Tsetse-Fly Investigation, Empangeni, Zululand.

Assistant Entomologist	R. H. Harris.

Locust Administration.

Chief Locust Officer	R. H. Williams.

Chemistry.

Chief of Division, Pretoria	St. C. O. Sinclair (Acting), D.Sc., F.C.S.
Assistant Chief, Johannesburg	J. McCrae, Ph.D., F.C.S., F.I.C.
Senior Chemist, Capetown	B. de C. Marchand, B.A., D.Sc.
Senior Chemist, Pretoria	A. Stead, B.Sc., F.C.S., F.I.C.
Senior Chemist, Johannesburg	J. Moir.
Senior Chemist, Johannesburg	J. S. Jamieson, F.I.C.

Division of Extension.

Chief of Division	H. S. du Toit, M.Sc., D.T.D.
Extension Officer	S. J. G. Hofmeyr.
Extension Officer	J. F. Burger, B.Sc.
Extension Officer	J. A. v. d. Merwe, B.Sc.
Extension Officer	M. v. d. Hoek, B.Sc.
Extension Officer	G. H. Cronje, M.Sc.
Extension Officer	D. Potgieter, B.Sc.
Extension Officer	B. J. de Klerk, M.Sc.
Extension Officer	A. G. S. du Toit, B.S.A.
Extension Officer	M. J. N. v. d. Merwe.
Extension Officer	J. C. Swart, B.Sc.
Domestic Science Officer	Miss M. J. Davidtsz, B.Sc.
Domestic Science Officer	Miss E. M. Ferguson.

Division of Economics and Markets.

Chief	F. E. Geldenhuys, B.A., B.Sc , Ph D.
Senior Economist	A. P. v. d. Post, B.A., B.Sc.
First Grade Economist	J. J. Jordaan.
First Grade Market Officer	F. J. du Toit, B.A.
Second Grade Economist	C. H. Neveling, B.A.
Second Grade Economist	C. J. Uys, M.Sc.
Second Grade Economist	A. A. Smit, M.Sc.
Second Grade Market Officer	R. J. Botha, B.A.

Co-operative Societies.

Registrar	J. Retief.
Inspector	E. R. Jacklin.
Inspector	C. A. F. Cairncross.
Inspector	J. N. Theron, B.Com.
Inspector	N. van Dalsen.
Inspector	A. R. Dragt.
Inspector	N. F. McMurray.

Schools of Agriculture and Experiment Stations.

Grootfontein, Middelburg (Cape), Principal	M. J. Joubert, B.Sc.(Agr.).
Grootfontein, Middelburg (Cape), Vice-Principal	H. Cooke, B.Sc.A.
Elsenburg, Muldersvlei (Cape), Principal ...	W. J. Lamont.
Elsenburg, Muldersvlei (Cape), Vice-Principal	W. A. K. Morkel, M.Sc.(Agr.).
Potchefstroom, Transvaal (Principal) ...	T. G. W. Reinecke, B.A., M.Sc.(Agr.).
Potchefstroom, Transvaal (Vice-Principal)...	P. J. Schreuder, B.A., Ph.D.
Cedara, Natal (Principal)	J. Fisher, B.Sc., N.D.A.
Glen, Orange Free State (Principal)... ...	E. Parish, B.Sc.
Beginsel Training Farm, Standerton, Transvaal, Superintendent	H. J. Every.
Bathurst Experiment Station, Experimentalist	K. Meldal-Johnsen.
Pietersburg Experiment Station, Officer in Charge	G. H. Trollope.

NOTE.—This list shows particulars as at latest possible date prior to publication.

DEPARTMENT OF AGRICULTURE.

Total Number of Officers Comprising the Staff: Year 1925.*

Office.	Administrative and Clerical Divisions.	Professional Divisions (Higher and Lower).	General Divisions (including Non-classified Officers).	Temporary.
HEAD OFFICE—	Number.	Number.	Number.	Number.
Administration	53	—	11	2
Publications §	10	—	2	—
DIVISIONS—				
Veterinary	24	52	768 †	8
Veterinary Education and Research	18	37	52	3
Animal and Field Husbandry	15	55	49	4
Botany and Plant Pathology	4	18	19 ‡	3
Chemistry	6	30	7	3
Entomology	5	15	12	6 ‖
Extension	6	12	1	1
Economics and Markets ...	18	9	—	
Total	159	228	921	24
SCHOOLS AND EXPERIMENT STATIONS—				
Elsenburg	5	14	13	—
Grootfontein	6	19	18	—
Cedara	3	14	10	—
Potchefstroom	6	14	16	—
Glen	4	13	13	—
Beginsel Training Farm ...	—	1	5	—
Total	24	75	75	—
GRAND TOTAL ...	183	303	996	* 24

*Establishment, excluding Natives, authorized in Estimates of Expenditure for 1924–1925.

† Including Dipping and Sheep Inspectors. ‡ Exclusive of 17 Citrus Canker Inspectors. § Including Library. ‖ Excluding Locust Officers.

DEPARTMENT OF AGRICULTURE.

Revenue and Expenditure for the Financial Years 1923-24 and 1924-25.

	1923–24.		1924–25.	
	Revenue.	Expenditure.	Revenue.	Expenditure.
AGRICULTURE.	£	£	£	£
Administrative and General ...	373	41,582	233	42,980
Veterinary	1,804	165,552	1,806	172,833
Veterinary Research	32,569	84,485	26,039	85,585
Sheep...	50	212,005	20	204,295
Dairying	1,362	11,494	2,874	13,586
Botany	46	28,085	86	27,695
Tobacco and Cotton...	1,719	14,317	2,146	15,686
Horticulture...	4,398	6,097	4,746	6,783
Viticulture	1,942	6,803	3,226	6,464
Entomology	1,561	16,002	1,457	16,667
Chemistry	24	8,782	1,245	27,486
Publications	—	4,466	—	4,967
Co-operation...	—	5,514	—	5,874
Extension	—	7,375	—	5,825
Guano Islands	63,046	60,714	91,915	56,852
Poultry Industry and Egg Inspection	744	1,298	956	1,935
Locust Administration	—	325,261	—	437,005
Payment of Bounties under Beef Export Bounties Act, 1923 ...	—	1,226	—	5,596
Telegraph and Telephone Services	—	—	—	8,346
Administrative Expenses of Drought Distress Relief Act, 1924 ...	—	—	—	5,253
Improvement of Stock	—	—	—	79
Ostrich Feather Propaganda ...	—	8,000	—	2,500
Miscellaneous	—	—	3,640	—
TOTAL ... ... £	109,638	1,009,058	140,389	1,154,292
AGRICULTURAL EDUCATION.				
Elsenburg	10,317	29,603	9,572	28,854
Grootfontein	8,966	32,021	8,690	31,918
Cedara	4,962	18,634	4,979	18,351
Potchefstroom	8,530	26,850	8,187	26,604
Glen	5,287	22,928	7,197	22,689
Beginsel Training Farm	686	4,078	920	3,883
Bathurst Experiment Station ...	27	1,504	21	1,634
Pietersburg Experiment Station...	143	1,253	122	1,086
Purchase of Stock	—	2,754	—	2,916
Scholarships and Bursaries ...	—	4,474	—	2,344
Hartebeestpoort Exp. Station ...	—	1,805	118	2,000
Hartebeestpoort Training Farm...	—	201	—	46
Guba Park Training Farm ...	1,065	1,176	—	—
Telegraphs and Telephones ...	—	—	—	853
Sundries	798	—	565	—
Faculty of Agriculture, T.U.C. ...	—	—	—	13,878
„ „ Stellenbosch	—	—	—	11,996
TOTAL ... ... £	40,776	147,281	40,371	169,052
GRAND TOTAL ... £	150,414	1,156,339	180,760	1,323,344

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JOURNAL OF THE DEPARTMENT OF AGRICULTURE.

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